



Product Service

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Report No.: 704062300251-00 part 1 of 2

TEST REPORT	
IEC 61215-series:2021	
TUV SUD Test Report for Terrestrial photovoltaic (PV) modules – Design qualification and type approval	
Report No.:	704062300251-00 part 1 of 2
Date of issue:	2023-10-15
Project handler:	Xiaoguang Song
Testing laboratory:	TÜV SÜD Certification and Testing (China) Co., Ltd.
Address:	No.151 Heng Tong Road, Shanghai 200070, P. R. China
Testing location:	Changzhou HuaYang Inspection and Testing Technology Co., Ltd NO.8 Lanxiang Road, Wujin Economic Development Zone, Changzhou, Jiangsu, China
Client:	Risen Energy Co., Ltd.
Client number:	82429
Address:	Meilin, Ninghai, 315609 Ningbo, Zhejiang, PEOPLE'S REPUBLIC OF CHINA
Contact person:	Shubo Yang
Standard:	This TUV SUD test report form is based on the following requirements: ☒ IEC 61215-1:2021 ☒ IEC 61215-2:2021 ☒ IEC 61215-1-1:2021 ☐ IEC 61215-1-2:2021 ☐ IEC 61215-1-3:2021 ☐ IEC 61215-1-4:2021
TRF number and revision:	IEC61215:2021, rev. 1
TRF originated by:	TUV SUD Product Service, Mr. Bo Xiangxi
Copyright blank test report:	This test report is based on the content of the standard (see above). The test report considered selected clauses of the a.m. standard(s) and experience gained with product testing. It was prepared by TUV SUD Product Service. TUV SUD Group takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.
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Scheme:	☒ TUV Mark ☐ without certification ☐ GS Mark ☐ NRTL Mark ☐ EU-Directive
Non-standard test method:	☒ No ☐ Yes, see details under Summary of testing
National deviations:	N/A
Number of pages (Report):	74
Number of pages (Attachments):	N/A
Compiled by:	Xiaoguang Song
Approved by:	Gang Huang

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Test sample:	See page 5~6 of this report
Type of test object:	Photovoltaic (PV) Module(s)
Trademark:	
Model and/or type reference:	See page 3~7 of this report
Rating(s):	See page 3~7 of this report
Manufacturer:	Risen Energy Co., Ltd.
Manufacturer number:	82429
Address:	Meilin, Ninghai, 315609 Ningbo, Zhejiang, PEOPLE'S REPUBLIC OF CHINA
Name and address of factory(ies) Risen Energy (CHANGZHOU) Co., Ltd (101449) No.1, Shuinan Road Industrial Concentration Area, Zhixi Town, Jintan District 213251 Changzhou City, Jiangsu Province PEOPLE'S REPUBLIC OF CHINA Risen Energy (YIWU) Co., Ltd (106291) No.599, Sufu Road Suxi Town 322000 Yiwu City, Zhejiang Province PEOPLE'S REPUBLIC OF CHINA Risen Energy (Anhui) Co., Ltd (113068) No.325, East Tongling Road Economic and Technological Development Zone 239000 Chuzhou City, Anhui Province PEOPLE'S REPUBLIC OF CHINA Risen Energy (Ningbo) Co.,Ltd (115158) No.1, Middle Xingke Road Ninghai County 315609 Ningbo City, Zhejiang Province PEOPLE'S REPUBLIC OF CHINA RISEN SOLAR TECHNOLOGY SDN BHD (115943) NO 3, JALAN HI-TECH 14, ZONE INDUSTRI FASA 4 KULIM HI-TECH PARK 09090 KULIM, KEDAH DARUL AMAN MALAYSIA Risen Energy (Baotou) Co., Ltd (119117) Baotou Jinshan Industrial Park, Guyang County, Baotou City 014200 Inner Mongolia Autonomous Region PEOPLE'S REPUBLIC OF CHINA Risen Solar (Ningbo) Technology Co., Ltd (122858) No. 5, Jinhai East Road, Binhai New Area Ninghai 315602 Ningbo City, Zhejiang Province PEOPLE'S REPUBLIC OF CHINA	
Sub-contractors/ tests (clause):	N/A
Name:	N/A
Order description:	☒ Complete test according to TRF
	☐ Partial test according to manufacturer's specifications
	☐ Preliminary test
	☐ Spot check
	☐ Others:
Date of order:	2023-10-16
Date of receipt of test item:	2023-01-18
Date(s) of performance of test:	2023-01-28/2023-04-30

Test item particulars:

See below for details

Purpose of the product (Description of intended use):

The PV modules for electricity generation systems with max.voltage of 1500VDC

Characteristic data (not shown on the marking plate):

Product Electrical Ratings:
Monofacial Module:

Module type	RSM144-10-575N	RSM144-10-580N	RSM144-10-585N	RSM144-10-590N
Voc [V] /Tolerance $\pm 3\%$	51.07	51.28	51.48	51.67
Vmp [V]	42.44	42.61	42.78	42.94
Imax [Adc]	13.57	13.63	13.70	13.76
Isc [Adc] /Tolerance $\pm 4\%$	14.40	14.45	14.51	14.57
Pmp [W] /Tolerance $\pm 3\%$	575	580	585	590
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	25	25	25	25
Module type	RSM144-10-595N	RSM144-10-600N	RSM144-10-605N	RSM144-10-610N
Voc [V] /Tolerance $\pm 3\%$	51.86	52.05	52.24	52.44
Vmp [V]	43.10	43.25	43.41	43.56
Imax [Adc]	13.83	13.89	13.96	14.03
Isc [Adc] /Tolerance $\pm 4\%$	14.62	14.68	14.73	14.79
Pmp [W] /Tolerance $\pm 3\%$	595	600	605	610
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	25	25	25	25

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Module type	RSM144-10-615N	RSM120-10-480N	RSM120-10-485N	RSM120-10-490N
Voc [V] /Tolerance $\pm 3\%$	52.63	42.48	42.69	42.90
Vmp [V]	43.72	35.30	35.48	35.65
I _{max} [A _{dc}]	14.09	13.62	13.70	13.77
I _{sc} [A _{dc}] /Tolerance $\pm 4\%$	14.85	14.46	14.52	14.59
P _{mp} [W] /Tolerance $\pm 3\%$	615	480	485	490
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	25	25	25	25
Module type	RSM120-10-495N	RSM120-10-500N	RSM120-10-505N	RSM108-10-430N
Voc [V] /Tolerance $\pm 3\%$	43.11	43.32	43.52	38.17
Vmp [V]	35.82	36.00	36.19	31.72
I _{max} [A _{dc}]	13.84	13.92	13.98	13.58
I _{sc} [A _{dc}] /Tolerance $\pm 4\%$	14.65	14.72	14.78	14.41
P _{mp} [W] /Tolerance $\pm 3\%$	495	500	505	430
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	25	25	25	25
Module type	RSM108-10-435N	RSM108-10-440N	RSM108-10-445N	RSM108-10-450N
Voc [V] /Tolerance $\pm 3\%$	38.39	38.61	38.83	39.03
Vmp [V]	31.90	32.08	32.27	32.43
I _{max} [A _{dc}]	13.66	13.74	13.82	13.90
I _{sc} [A _{dc}] /Tolerance $\pm 4\%$	14.49	14.56	14.63	14.70

Pmp [W] /Tolerance $\pm 3\%$	435	440	445	450
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	25	25	25	25
Module type	RSM108-10-455N	RSM108-10-460N	RSM144-9-555N	RSM144-9-560N
Voc [V] /Tolerance $\pm 3\%$	39.23	39.43	51.17	51.37
Vmp [V]	32.62	32.81	42.80	43.00
I _{max} [Adc]	13.97	14.04	12.99	13.04
I _{sc} [Adc] /Tolerance $\pm 4\%$	14.77	14.84	13.83	13.89
Pmp [W] /Tolerance $\pm 3\%$	455	460	555	560
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	25	25	25	25
Module type	RSM144-9-565N	RSM144-9-570N	RSM144-9-575N	RSM144-9-580N
Voc [V] /Tolerance $\pm 3\%$	51.57	51.77	51.97	52.17
Vmp [V]	43.20	43.40	43.59	43.79
I _{max} [Adc]	13.10	13.15	13.21	13.26
I _{sc} [Adc] /Tolerance $\pm 4\%$	13.95	14.00	14.06	14.12
Pmp [W] /Tolerance $\pm 3\%$	565	570	575	580
Maximum system voltage [V]	1500	1500	1500	1500

Maximum Over-Current Protection Rating [A]	25	25	25	25
Module type	RSM144-9-585N	RSM144-9-590N	RSM120-9-460N	RSM120-9-465N
Voc [V] /Tolerance $\pm 3\%$	52.37	52.55	42.48	42.68
Vmp [V]	43.98	44.16	35.53	35.73
I _{max} [A _{dc}]	13.31	13.36	12.97	13.03
I _{sc} [A _{dc}] /Tolerance $\pm 4\%$	14.18	14.24	13.80	13.87
P _{mp} [W] /Tolerance $\pm 3\%$	585	590	460	465
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	25	25	25	25
Module type	RSM120-9-470N	RSM120-9-475N	RSM120-9-480N	RSM120-9-485N
Voc [V] /Tolerance $\pm 3\%$	42.88	43.08	43.28	43.48
Vmp [V]	35.92	36.11	36.31	36.50
I _{max} [A _{dc}]	13.10	13.17	13.24	13.31
I _{sc} [A _{dc}] /Tolerance $\pm 4\%$	13.94	14.02	14.09	14.17
P _{mp} [W] /Tolerance $\pm 3\%$	470	475	480	485
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	25	25	25	25
Module type	RSM120-9-490N	RSM108-9-415N	RSM108-9-420N	RSM108-9-425N

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Voc [V] /Tolerance $\pm$ 3%	43.68	38.67	38.87	39.07
Vmp [V]	36.70	32.37	32.56	32.75
Imax [Adc]	13.37	12.84	12.92	13.00
Isc [Adc] /Tolerance $\pm$ 4%	14.23	13.70	13.78	13.86
Pmp [W] /Tolerance $\pm$ 3%	490	415	420	425
Maximum system voltage [V]	1500	1500	1500	1500
Maximum Over-Current Protection Rating [A]	25	25	25	25
Module type	RSM108-9-430N	RSM108-9-435N	RSM108-9-440N	
Voc [V] /Tolerance $\pm$ 3%	39.27	39.47	39.67	
Vmp [V]	32.95	33.15	33.34	
Imax [Adc]	13.07	13.13	13.20	
Isc [Adc] /Tolerance $\pm$ 4%	13.94	14.00	14.08	
Pmp [W] /Tolerance $\pm$ 3%	430	435	440	
Maximum system voltage [V]	1500	1500	1500	
Maximum Over-Current Protection Rating [A]	25	25	25	
Note: Further qualification for higher and/or lower output power see annex 3				

Information for testing sample:

Sample #	Sample Group ID	Type/model	Sample S/N	Remark
Item1				
HA2023TL-0093-001X	A	RSM144-10-590N	471629I0893827	Control module
HA2023TL-0093-004X	B	RSM144-10-590N	471629I0893828	
HA2023TL-0093-005X	C1	RSM144-10-590N	471629I0893852	UV-DML-TC-HF
HA2023TL-0093-006X	C2	RSM144-10-590N	471629I0893845	UV-DML-TC-HF
HA2023TL-0093-007X	E1	RSM144-10-590N	471931I3397697	DH1000
HA2023TL-0093-008X	E2	RSM144-10-590N	471931I3397698	DH1000
HA2023TL-0093-009X	D1	RSM144-10-590N	471629I0893819	TC200
HA2023TL-0093-010X	D2	RSM144-10-590N	471629I0893823	TC200
HA2023TL-0093-024X	F1	RSM144-10-590N	471629I0893829	PID
HA2023TL-0093-025X	F2	RSM144-10-590N	471629I0893830	PID
HA2023TL-0093-026X	F3	RSM144-10-590N	471629I0893831	PID
HA2023TL-0093-027X	F4	RSM144-10-590N	471629I0893832	PID
HA2023TL-0093-020X	—	RSM144-10-615N	471629I0893854	*Higher output power
HA2023TL-0093-021X	—	RSM144-10-615N	471629I0893855	*Higher output power
HA2023TL-0093-022X	—	RSM144-10-575N	471629I0893825	*Lower output power
HA2023TL-0093-023X	—	RSM144-10-575N	471629I0893828	*Lower output power
Item2				
HA2023TL-0093-028X	—	RSM144-9-555N	471628I0885732	*Lower output power
HA2023TL-0093-029X	—	RSM144-9-555N	471628I0885733	*Lower output power
HA2023TL-0093-030X	—	RSM144-9-590N	471628I0885728	*Higher output power
HA2023TL-0093-031X	—	RSM144-9-590N	471628I0885729	*Higher output power
Remark: * Lower and higher output power test see annex 3				

Attachments:	
	attachment number / number of pages
Installation manual	Attachment 1: 47 pages
Drawings mechanical	Refer to annex 2 of report No. 704062300251-00 Part 2 of 2
Circuit diagram	Refer to annex 2 of report No. 704062300251-00 Part 2 of 2
Photographs	Attachment 2: 6 pages
Component datasheets / certificates	Attachment 3: 29 pages
Others:	
Product Description Sheet (Manufacturers and type references)	Annex 1, _6_ pages
Test table for verifying other stabilization procedure	Annex 2, _N/A_ pages
Lower and higher output power modules	Annex 3, _4_ pages
List of test equipment used	Annex 4, _N/A_ pages
If additional information is necessary, please provide	
N/A	
Picture of the product: Refer to 704062300251-00 DOC_TUV MARK_E	

Summary of testing:

Item1:

Full tests according to IEC 61215-1:2021, IEC 61215-1-1:2021, IEC 61215-2:2021 were conducted on representative model RSM144-10-590N.

Higher end and lower end power class tests according to IEC 61215-1:2021, IEC 61215-1-1:2021, IEC 61215-2:2021 were conducted on model RSM144-10-615N, RSM144-10-575N.

Below model types were included:(Model with 182.2 × 96mm TOPCon cell)

a) RSM144-10-xxxN, xxx= 575 to 615 in steps of 5

b) RSM120-10-xxxN, xxx= 480 to 505 in steps of 5

c) RSM108-10-xxxN, xxx= 430 to 460 in steps of 5

xxx is standing for rated output power at STC

Above types of model are identical to tested model RSM144-10-590N except for power ratings, cell's numbers, module size.

Item2:

Based on item 1, Below change were found:

1, Add cell, RSTCS182B(16BB), Cell dimensions L x W: 182.2 × 91mm, manufactured by Risen Energy Co., Ltd.

Remark: Only decreased in cell size from 182.2 × 96mm to 182.2 × 91mm for above new cell RSTCS182B(16BB).

Below model types were included:(Model with 182.2 × 91mm TOPCon cell)

d) RSM144-9-xxxN, xxx= 555 to 590 in steps of 5

e) RSM120-9-xxxN, xxx= 460 to 490 in steps of 5

f) RSM108-9-xxxN, xxx= 415 to 440 in steps of 5

xxx is standing for rated output power at STC

Higher end and lower end power class tests according to IEC 61215-1:2021, IEC 61215-1-1:2021, IEC 61215-2:2021 were conducted on model RSM144-9-590N, RSM144-9-555N.

Above types of model are identical to tested model RSM144-9-590N, RSM144-9-555N except for power Ratings, cell's numbers, module size.

☐ deviation(s) found

☒ no deviations found

Additional information on Non-standard test method(s)

Sub clause:

Page:

Rational:

Copy of marking plate:

risen Risen Energy Co.,Ltd. Website:www.risenenergy.com E-mail:info@risenenergy.com Add:Meilin,Ninghai,Ningbo,Zhejiang 315609,P.R.China. IEC61215-1:2021,IEC61215-2:2021, IEC61215-1-1:2021 and IEC61730-1/2:2023 Connector see manual for designated connector: Zhejiang Twinstel Electronic Technology Co.Ltd.PV-SY02  I* M-G5.6	Model Type: RSM144-10-590N Rated Maximum Power(Pmax) 590W Power Measurement Uncertainty ±3% Maximum Power Voltage(Vmp) 42.94V Maximum Power Current(Imp) 13.76A Open Circuit Voltage(Voc) 51.67V±3% Short Circuit Current(Isc) 14.57A±4% Power Selection 0~5W	STC AM1.5 E=1000W/m² Tc=25°C Min. Design Load [Pa] +3600Pa,-1600Pa Min. Test Load [Pa] +5400Pa,-2400Pa Module [T85]max [°C] 70 Maximum System Voltage DC1500V Safety Class Class II Maximum Series Fuse Rating 25A Dimensions 2382*1134*30mm Weight 30kg	    Do not disconnect under load. This module produces electricity when exposed to light. Please read the installation and operation manual. Nameplate is posted on the rear side of the module. Made in China WARNING
risen Risen Energy Co.,Ltd. Website:www.risenenergy.com E-mail:info@risenenergy.com Add:Meilin,Ninghai,Ningbo,Zhejiang 315609,P.R.China. IEC61215-1:2021,IEC61215-2:2021, IEC61215-1-1:2021 and IEC61730-1/2:2023 Connector see manual for designated connector: Zhejiang Twinstel Electronic Technology Co.Ltd. PV-SY02  I* *-G**	Model Type: RSM144-9-555N Rated Maximum Power(Pmax) 555W Power Measurement Uncertainty ±3% Maximum Power Voltage(Vmp) 42.80V Maximum Power Current(Imp) 12.99A Open Circuit Voltage(Voc) 51.17V±3% Short Circuit Current(Isc) 13.83A±4% Power Selection 0~5W	STC AM1.5 E=1000W/m² Tc=25°C Min. Design Load [Pa] +3600Pa,-1600Pa Min. Test Load [Pa] +5400Pa,-2400Pa Module [T85]max [°C] 70 Maximum System Voltage DC1500V Safety Class Class II Maximum Series Fuse Rating 30A Dimensions 2278*1134*30mm Weight 27kg	    Do not disconnect under load. This module produces electricity when exposed to light. Please read the installation and operation manual. Nameplate is posted on the rear side of the module. Made in China WARNING

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Possible test case verdicts:

test case does not apply to the test object: N/A (not applicable / not included in the order)

test object does meet the requirement: P (Pass)

test object does not meet the requirement: F (Fail)

General remarks:

"(see remark #)" refers to a remark appended to the report.

"(see appended table)" refers to a table appended to the report.

*Throughout this report **a comma** is used as the decimal separator.*

The test results presented in this report relate only to the object tested.

This report shall not be reproduced except in full without the written approval of the testing laboratory.

10. Modifications:

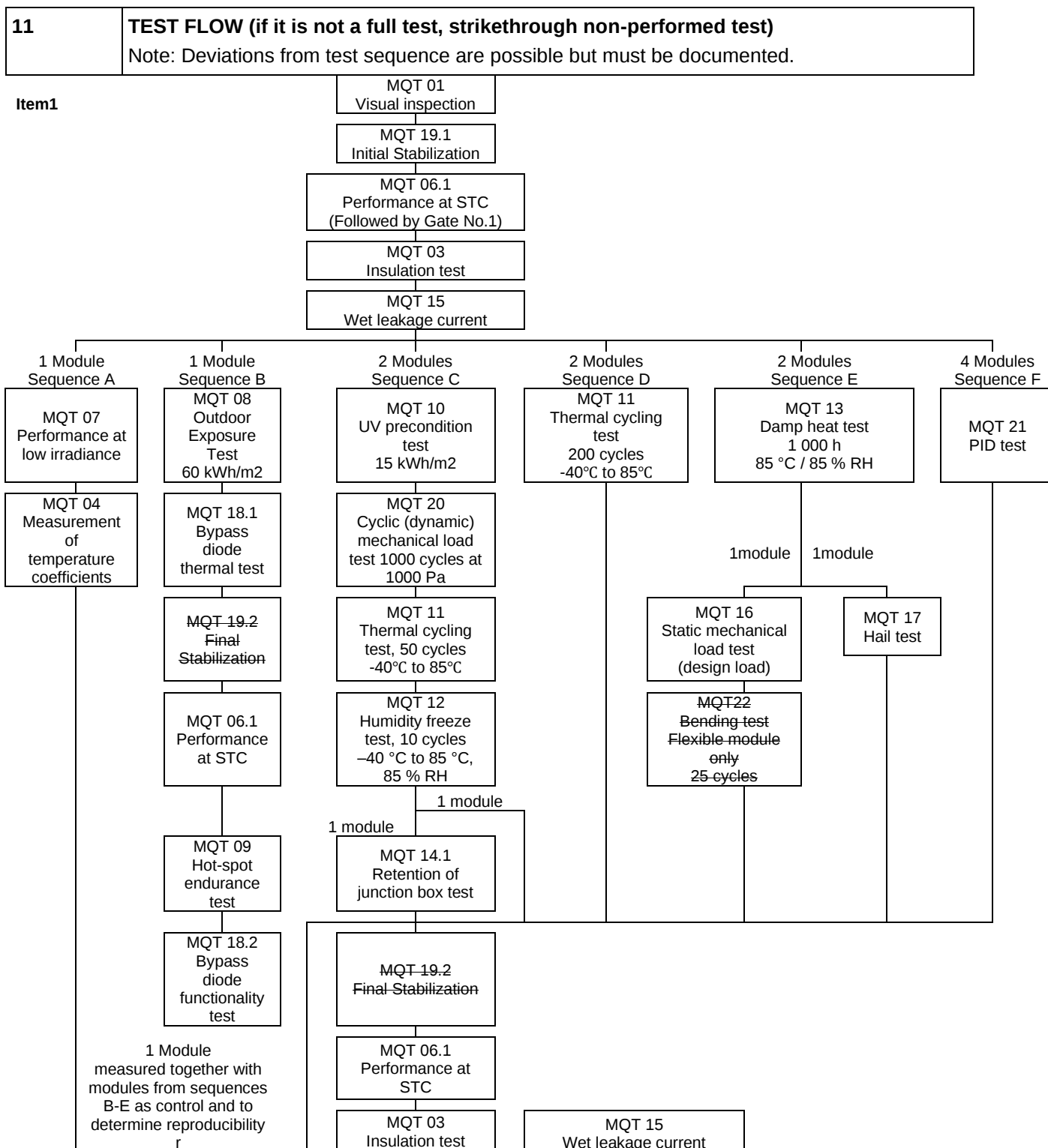
Modifications:

- ☒ Initial module design qualification
- ☐ Extension of module design qualification
- ☐ Original test report ref. No.:

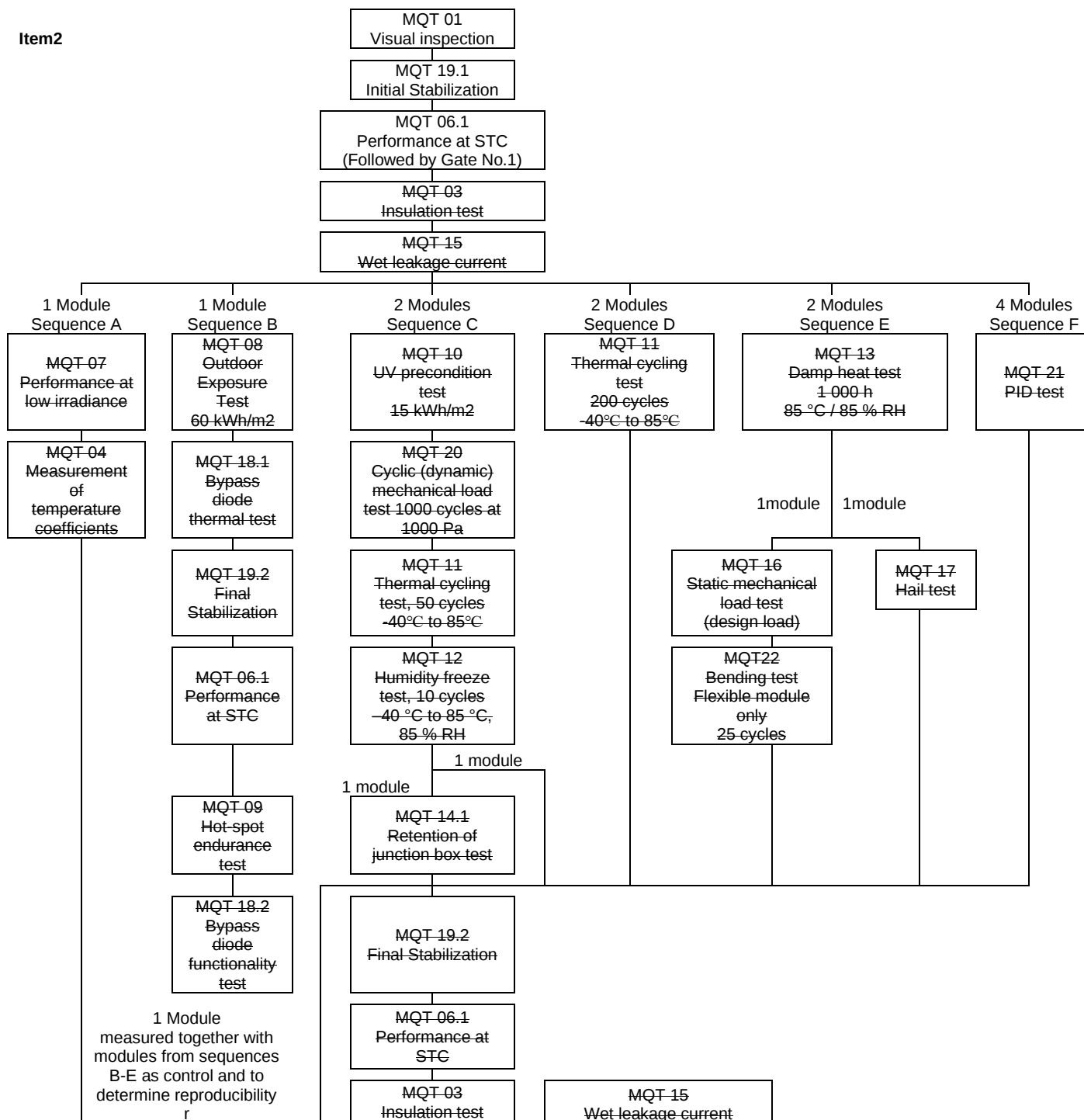
Model differences and modification:

- | | |
|--|---|
| ☐ Test programs for crystalline silicon PV modules | ☐ Test programs for thin-film PV modules |
| ☐ 4.2.1 Modification to frontsheet | ☐ 4.3.1 Modification to frontsheet |
| ☐ 4.2.2 Modification to encapsulation system | ☐ 4.3.2 Modification to encapsulation system |
| ☐ 4.2.3 Modification to cell technology | ☐ 4.3.3 Modification to front contact (e. g. TCO) |
| ☐ 4.2.4 Modification to cell and string interconnect material or technique | ☐ 4.3.4 Modification to cell technology |
| ☐ 4.2.5 Modification to backsheet | ☐ 4.3.5 Modification to cell layout |
| ☐ 4.2.6 Modification to electrical termination | ☐ 4.3.6 Modification to back contact |
| ☐ 4.2.7 Modification to bypass diode | ☐ 4.3.7 Modification to edge deletion |
| ☐ 4.2.8 Modification to electrical circuitry | ☐ 4.3.8 Modification to interconnect material or technique |
| ☐ 4.2.9 Modification to edge sealing | ☐ 4.3.9 Modification to backsheet |
| ☐ 4.2.10 Modification to frame and/or mounting structure | ☐ 4.3.10 Modification to electrical termination |
| ☐ 4.2.11 Change in PV module size | ☐ 4.3.11 Modification to bypass diode |
| ☐ 4.2.12 Higher or lower output power (by 10 % or more) with the identical design and size and using the identical cell process | ☐ 4.3.12 Modification to edge sealing |
| ☐ 4.2.13 Increase of over-current protection rating | ☐ 4.3.13 Modification to frame and/or mounting structure |
| ☐ 4.2.14 Increase of system voltage | ☐ 4.3.14 Change in PV module size |
| ☐ 4.2.15 Change in cell fixing tape | ☐ 4.3.15 Higher or lower output power (by 10 % or more) with the identical design and size |
| | ☐ 4.3.16 Increase of over-current protection rating |
| | ☐ 4.3.17 Increase of system voltage |

Note: The clause references modifications extracted from IEC 62915



Item2



IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
5. Marking and Documentation			P
5.1	Name Plate		
	All electrical data shall be shown as relative to STC (1 000 W/m ² , 25 °C, AM1.5 according to IEC TS 61836), except for bifacial modules where two irradiance levels are required, 1 000 W/m ² and BNPI (higher irradiance at which nameplate verification is performed for bifacial modules, corresponding to 1 000 W/m ² on the module front and 135 W/m ² on the module rear, applied in any method allowed by IEC TS 60904-1-2).	Marked on label	P
	International symbols are used where applicable.	Marked on label	P
	The module includes clear and indelible markings:		
	a. Name, registered trade name or registered trade mark of manufacturer		P
	b. Type or model number designation	RSM144-10-590N for example	P
	c. Serial number (unless marked on other part of product)	471629I0893827 for example	P
	d. Date and place of manufacture, alternatively serial number allowing to trace the date and place of manufacture;	serial number allowing to trace the date and place of manufacture	P
	e. Maximum system voltage	1500V DC	P
	f. Class of protection against electrical shock	Class II	P
	g. Voltage at open-circuit or Voc including tolerances. For bifacial modules, open-circuit voltage shall be reported at two irradiance levels. The first required irradiance level is 1 000 W/m ² . The second required irradiance is BNPI	Marked on label	P
	h. Current at short-circuit or Isc including tolerances. For bifacial modules, short-circuit current shall be reported at two irradiance levels, defined in 5.1g	Marked on label	P
	i. Module maximum power or Pmax including tolerances. For bifacial modules, Pmax shall be reported at the two irradiance levels, defined in 5.1g	Marked on label	P

IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
	j. For bifacial modules the following information including tolerances, shall be given on the nameplate: The values for the short-circuit current bifaciality coefficient ϕ_{sc} , the open-circuit voltage bifaciality coefficient ϕ_{Voc} , and the maximum power bifaciality coefficient ϕ_{Pmax} , measured at STC as defined in IEC TS 60904-1-2	Marked on label	P
	k. For flexible modules, the minimum radius of curvature		N/A
5.2	Documentation		
5.2.1	Minimum requirements		
	Modules are supplied with documentation describing the methods of electrical and mechanical installation as well as the electrical ratings of the module		P
	The documentation states the class of protection against electrical shock under which the module has been qualified and any specific limitations required for that class.		P
	The documentation assures that installers and operators receive appropriate and sufficient documentation for safe installation, use, and maintenance of the PV modules.		P
5.2.2	Information given in the documentation		P
	a. All information required under 5.1 e) to i)	Refer to manual document	P
	b. Overcurrent protection device type and rating are e.g. given in IEC 60269-6	Refer to manual document	P
	Maximum series/parallel module configuration is recommended		P
	c. Manufacturer's stated tolerance for Voc, Isc and maximum power output under standard test conditions		P
	d. Temperature coefficient for voltage at open-circuit		P
	e. Temperature coefficient for maximum power		P
	f. Temperature coefficient for short-circuit current		P
	All electrical data mentioned above shown as relative to standard test conditions (1 000 W/m ² , 25 °C, AM 1,5 according to IEC TS 61836)		P
	g. Performance at low irradiance (MQT 07) is specified		N/A
	International symbols used where applicable		P

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IEC 61215-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Compliance checked by inspection and MQT 04 through MQT 07		P
	The electrical documentation includes a detailed description of the electrical installation wiring method to be used		
	h. The minimum cable diameters for modules intended for field wiring		P
	i. Any limitations on wiring methods and wire management that apply to the wiring compartment or box;		P
	j. The size, type, material and temperature rating of the conductors to be used		P
	k. Type of terminals for field wiring		N/A
	l. Specific PV connector model/types and manufacturer to which the module connectors are mated		P
	m. The bonding method(s) to be used (if applicable); all provided or specified hardware is identified in the documentation	Refer to manual document	P
	n. The type and ratings of bypass diode to be used (if applicable)	Refer to manual document	P
	o. limitations to the mounting situation (e.g., slope, orientation, mounting means, cooling)	Refer to manual document	P
	p. A statement indicating the fire rating(s) and the applied standard and the limitations to that rating (e.g., installation slope, sub-structure or other applicable installation information)		P
	q. A statement indicating the design load per each mechanical means for securing the module as evaluated during the static mechanical load test according to MQT 16. At discretion of the manufacturer the test load and/or the safety factor γ_m may be noted, too	Designed load: Positive:3600Pa Negative:1600Pa Safety factor for both sides: 1.5	P
	The installation instructions include relevant parameters specified by manufacturer or the following statement or the equivalent: <i>"Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of I_{sc} and V_{oc} marked on this module should be multiplied by a factor of 1,25 when determining component voltage ratings, conductor current ratings, and size of controls connected to the PV output."</i>		P
5.2.3	Assembly instructions		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Provided with a product shipped in subassemblies, detailed and adequate to the degree required to facilitate complete and safe assembly of the product		N/A
Supplementary information:			

7. Pass Criteria						P
7.2	Power output and electric circuitry					P
7.2.1	Verification of rated label values (Gate No. 1)					P
	Manufacturer's tolerances and Laboratory uncertainties					P
		t ₁	t ₂	t ₃	t ₄	—
	manufacturer's rated lower/upper production tolerance in %	-3	+3	+4	+3	
		m ₁	m ₂	m ₃		
	measurement uncertainty in % of laboratory	2.16	1.00	2.40		
	Laboratory reproducibility r:	0.23%				
	After stabilization, each individual module meets the requirements					P
	P _{max} :		See Table 03.1, Table 03.3			P
	V _{oc} :		See Table 03.1, Table 03.3			P
	I _{sc} : :		See Table 03.1, Table 03.3			P
	After stabilization the arithmetic average $\overline{P}_{max}$ of all modules meet the requirements.		See Table 03.1, Table 03.3			P
7.2.2	Maximum power degradation during type approval testing (Gate #2)					P
	At the end of each test sequence or for sequence B after bypass diode test, each test sample meets the requirements for P _{max}					P
7.2.3	Electrical circuitry					P
	Samples do not exhibit an open-circuit during the tests					P
7.3	Visual defects					P
	There is no visual evidence of a major defect.					P
7.4	Electrical safety					P

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Clause	Requirement + Test	Result - Remark	Verdict
	The insulation test (MQT 03) requirements are met at the beginning and the end of each sequence		P
	The wet leakage current test (MQT 15) requirements met at the beginning and at the end of each sequence		P
	Specific requirements of the individual tests are met		P
Supplementary information:			

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Clause	Requirement + Test	Result - Remark	Verdict

4. Testing Overview			P
	Initial examination	All modules	P
4.1	Visual inspection (MQT 01)):	See Table 01	P
4.19.5	Initial stabilization (MQT 19.1):	See Table 02.1 - 02.6	P
4.6	Performance at STC &BNPI (MQT 06.1)	See Table 03.1 - 03.3	P
4.3	Insulation test(MQT 03):	See Table 04	P
4.15	Wet leakage current test(MQT 15):	See Table 05	P

Sequence A	1 Modules	Samples A	P
4.7	Performance at low irradiance(MQT 07).....:	See Table 06.1 - 06.2	P
4.4	Measurement of temperature coefficients(MQT 04):	See Table 07	P

Sequence B	1 Module	Sample B	P
4.8	Outdoor exposure test(MQT 08):	See Table 08	P
4.18.1	Bypass diode thermal test (MQT 18.1)		P
	Maximum allowed junction temperature:		—
	Calculated junction temperature:		—
	Final measurements.....:	See Table 09	P
4.18.2	Bypass diode functionality test (MQT 18.2):	See Table 10	P
4.19.6	Final stabilization (MQT 19.2):	See Table 10.1 – 10.3	N/A
4.9	Hot spot endurance test (MQT 09):	See Table 11	P

Sequence C	2 Modules	Samples C1; C2	P
4.10	UV preconditioning test (MQT 10):	See Table 12.1 - 12.6	P
4.20	Cyclic (dynamic) mechanical load test (MQT 20)	See Table 13	P
4.11	Thermal cycling test 50 cycles (MQT 11).....:	See Table 14	P
4.12	Humidity-freeze test (MQT 12).....:	See Table 15	P

Sequence C1	1 Module	Sample C1	P
4.14.2	Retention of junction box on mounting surface (MQT 14.1):	See Table 16	P
4.14.3	Test of cord anchorage (MQT 14.2)		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
4.14.3.1	The junction box, separate from the module, shall be tested to IEC 62790 "Test of cord anchorage" and shall meet the requirements therein	See report No.: 70.407.17.075.05.09	P
Sequence D	2 Modules	Sample D1; D2	P
4.11	Thermal cycling test 200 cycles (MQT 11)	See Table 17	P
Sequence E	2 Modules	Samples E1; E2	P
4.13	Damp heat test (MQT 13)	See Table 18	P
4.19.6	Final stabilization (MQT 19.2)	See Table 23.3	N/A
Sequence E1	1 Module	Sample E1	P
4.16	Static mechanical load test (MQT 16)	See Table 19	P
4.22	Bending test (MQT 22)	See Table 20	N/A
Sequence E2	1 Module	Sample E2	P
4.17	Hail test (MQT 17)	See Table 21	P
Sequence F	4 Module	Sample F1; F2; F3; F4	P
4.21	Potential induced degradation test (MQT 21)	See Table 22	P
4.19.6	Final stabilization (MQT 19.2)	See Table 23.4, 23.6, 23.7	N/A
	Final measurement	All modules for Sequence C, D, E, F; Control module for Sequence A	P
4.19.6	Final stabilization (MQT 19.2)	See Table 23.1 - 23.2	N/A
4.6	Performance at STC&BNPI(MQT 06.1)	See Table 23.5, 23.8	P
4.3	Insulation test(MQT 03)	See Table 23.9	P
4.15	Wet leakage current test(MQT 15)	See Table 23.10	P

IEC 61215-2			
Clause	Requirement + Test	Result - Remark	Verdict

TABLE 01: MQT 01 ini: Initial Visual inspection			P
Test Date [YYYY-MM-DD]..... : 2023-01-28			—
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2023TL-0093-001X	No major visual defects found		P
HA2023TL-0093-004X	No major visual defects found		P
HA2023TL-0093-005X	No major visual defects found		P
HA2023TL-0093-006X	No major visual defects found		P
HA2023TL-0093-007X	No major visual defects found		P
HA2023TL-0093-008X	No major visual defects found		P
HA2023TL-0093-009X	No major visual defects found		P
HA2023TL-0093-010X	No major visual defects found		P
HA2023TL-0093-024X	No major visual defects found		P
HA2023TL-0093-025X	No major visual defects found		P
HA2023TL-0093-026X	No major visual defects found		P
HA2023TL-0093-027X	No major visual defects found		P
Supplementary information:			

TABLE 02: MQT 19.1 ini: Initial stabilization							P
TABLE 02.1: MQT 06.1 ini: Performance at STC before initial stabilization (Front side)							P
Test Date [YYYY-MM-DD]..... : 2023-01-28							—
Test method..... : ☒ Simulator ☐ Natural sunlight							—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
HA2023TL-0093-001X	14.315	51.137	13.642	43.150	588.647	80.41	P
HA2023TL-0093-004X	14.295	51.193	13.637	43.018	586.643	80.16	P
HA2023TL-0093-005X	14.347	51.093	13.701	42.995	589.075	80.36	P
HA2023TL-0093-006X	14.322	51.233	13.722	42.915	588.865	80.25	P
HA2023TL-0093-007X	14.275	51.210	13.628	43.099	587.334	80.34	P
HA2023TL-0093-008X	14.347	51.187	13.632	43.161	588.352	80.11	P
HA2023TL-0093-009X	14.316	51.274	13.704	43.135	591.111	80.53	P

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Clause	Requirement + Test				Result - Remark		Verdict
HA2023TL-0093-010X	14.339	51.144	13.656	43.130	588.960	80.31	P
HA2023TL-0093-024X	14.329	51.195	13.720	43.131	591.755	80.67	P
HA2023TL-0093-025X	14.323	51.145	13.654	43.238	590.390	80.59	P
HA2023TL-0093-026X	14.295	51.157	13.621	43.248	589.079	80.55	P
HA2023TL-0093-027X	14.285	51.148	13.652	43.143	588.977	80.61	P
Supplementary information:							
TABLE 02.2: MQT 06.1 ini: Performance at STC before initial stabilization (Back side)							—
Test Date [YYYY-MM-DD]				—			—
Test method				☐ Simulator ☐ Natural sunlight			—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
Supplementary information:							
TABLE 02.3: MQT 06.1 ini: Performance at BNPI (front side irradiance 1000 W/m², back side irradiance 135 W/m², 25 °C, AM 1.5) before initial stabilization							—
Test Date [YYYY-MM-DD]				—			—
Test method				☐ Simulator ☐ Natural sunlight			—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
Supplementary information:							
TABLE 02.4: MQT 19.1 ini: Initial Stabilization procedure							P
Light exposure method				☒ Simulator ☐ Natural sunlight			
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x				1			

IEC 61215-2							
Clause	Requirement + Test				Result - Remark		Verdict
Sample #	HA2023TL-0093-001X	Test Date (YYYY-MM-DD) start/end..... :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	588.647	—	—
1	5	800-1000	50±10	3.2	590.395	—	—
2	5	800-1000	50±10	3.2	591.188	0.43	Yes

Sample #	HA2023TL-0093-004X	Test Date (YYYY-MM-DD) start/end..... :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	586.643	—	—
1	5	800-1000	50±10	3.2	587.380	—	—
2	5	800-1000	50±10	3.1	590.028	0.58	Yes

Sample #	HA2023TL-0093-005X	Test Date (YYYY-MM-DD) start/end..... :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	589.075	—	—
1	5	800-1000	50±10	3.1	590.770	—	—
2	5	800-1000	50±10	3.1	591.760	0.45	Yes

Sample #	HA2023TL-0093-006X	Test Date (YYYY-MM-DD) start/end..... :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	588.865	—	—
1	5	800-1000	50±10	3.1	590.558	—	—
2	5	800-1000	50±10	3.1	591.248	0.40	Yes
Sample #	HA2023TL-0093-007X	Test Date (YYYY-MM-DD) start/end..... :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)

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Clause	Requirement + Test				Result - Remark		Verdict
Initial	—	—	—	—	587.334	—	—
1	5	800-1000	50±10	3.2	588.962	—	—
2	5	800-1000	50±10	3.2	590.044	0.46	Yes
Sample #	HA2023TL-0093-008X	Test Date (YYYY-MM-DD) start/end..... :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	588.352	—	—
1	5	800-1000	50±10	3.2	590.255	—	—
2	5	800-1000	50±10	3.1	591.872	0.60	Yes
Sample #	HA2023TL-0093-009X	Test Date (YYYY-MM-DD) start/end..... :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	591.111	—	—
1	5	800-1000	50±10	3.1	592.427	—	—
2	5	800-1000	50±10	3.2	594.194	0.52	Yes
Sample #	HA2023TL-0093-010X	Test Date (YYYY-MM-DD) start/end..... :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	588.960	—	—
1	5	800-1000	50±10	3.2	590.665	—	—
2	5	800-1000	50±10	3.1	591.638	0.45	Yes
Sample #	HA2023TL-0093-024X	Test Date (YYYY-MM-DD) start/end..... :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	591.755	—	—
1	5	800-1000	50±10	3.1	592.068	—	—
2	5	800-1000	50±10	3.1	593.639	0.32	Yes
Sample #	HA2023TL-0093-025X	Test Date (YYYY-MM-DD) start/end..... :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	(P _{max} – P _{min}) / P _{average} (%)	Stable (Yes/No)

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Clause	Requirement + Test					Result - Remark			Verdict		
Pmax(lab) lower limit (W) :					See table below: Pmax [W] – Min calc.					—	
$\bar{P}_{max}(Lab)$ lower limit (W) :					579.670					—	
Voc(lab) upper limit (V) :					See table below: Voc [V] Max. calc.					—	
Isc (lab) upper limit (A) :					See table below: Isc [A] Max. calc.					—	
Test method :					☒ Simulator ☐ Natural sunlight					—	
Sample #	Isc [A]		Voc [V]		Imp [A]	Vmp [V]	Pmax [W]		FF [%]	Result	
	Meas.	Max. calc.	Meas.	Max. calc.			Meas.	Min. calc.			
HA2023TL-0093-001X	14.341	14.859	51.248	52.785	13.674	43.235	591.188	562.280	80.44	P	
HA2023TL-0093-004X	14.347	14.859	51.250	52.785	13.726	42.987	590.028	562.280	80.24	P	
HA2023TL-0093-005X	14.368	14.859	51.146	52.785	13.759	43.008	591.760	562.280	80.52	P	
HA2023TL-0093-006X	14.390	14.859	51.285	52.785	13.773	42.929	591.248	562.280	80.11	P	
HA2023TL-0093-007X	14.312	14.859	51.234	52.785	13.689	43.103	590.044	562.280	80.47	P	
HA2023TL-0093-008X	14.398	14.859	51.217	52.785	13.707	43.181	591.872	562.280	80.26	P	
HA2023TL-0093-009X	14.382	14.859	51.341	52.785	13.765	43.167	594.194	562.280	80.47	P	
HA2023TL-0093-010X	14.389	14.859	51.241	52.785	13.699	43.187	591.638	562.280	80.24	P	
HA2023TL-0093-024X	14.379	14.859	51.218	52.785	13.747	43.184	593.639	562.280	80.61	P	
HA2023TL-0093-025X	14.364	14.859	51.179	52.785	13.696	43.284	592.823	562.280	80.64	P	
HA2023TL-0093-026X	14.373	14.859	51.218	52.785	13.666	43.286	591.544	562.280	80.36	P	
HA2023TL-0093-027X	14.333	14.859	51.189	52.785	13.701	43.194	591.815	562.280	80.66	P	
Average	—							591.816	579.670	—	P
Supplementary information: The limit values are calculated considering manufacturer's tolerances t of rated nameplate values and laboratory measurement uncertainties m .											

TABLE 03.2: MQT 06.1 ini: Performance at STC after initial stabilization(Back side)										—
Test Date [YYYY-MM-DD]					—					—
Test method					☐ Simulator ☐ Natural sunlight					—

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Clause	Requirement + Test						Result - Remark			Verdict
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	ϕ_{Isc}	ϕ_{Voc}	ϕ_{Pmax}	Result
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
Supplementary information:										

TABLE 03.3: MQT 06.1 ini: Performance at BNPI (front side irradiance 1000 W/m ² , backside irradiance 135 W/m ² , 25 °C, AM 1.5) after initial stabilization										—	
Test Date [YYYY-MM-DD]..... :					—					—	
Pmax(lab) lower limit (W) :					—					—	
$\bar{P}_{max}(Lab)$ lower limit (W) :					—					—	
Voc(lab) upper limit (V) :					—					—	
Isc (lab) upper limit (A) :					—					—	
Test method..... :					☐ Simulator ☐ Natural sunlight					—	
Sample #	Isc [A]		Voc [V]		Imp [A]	Vmp [V]	Pmax [W]		FF [%]	Result	
	Meas.	Max. calc.	Meas.	Max. calc.			Meas.	Min. calc.			
—	—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	—	
Average	—						—	—	—	—	
Supplementary information: The limit values are calculated considering manufacturer’s tolerances <i>t</i> of rated nameplate values and laboratory measurement uncertainties <i>m</i> .											
TABLE 04: MQT 03 ini: Initial Insulation test										P	
Test Date [YYYY-MM-DD].....:					2023-02-06					—	
Test Voltage applied [V]					8000/1500					—	
Size of module [m ²]					2.7					—	
Required Resistance [MΩ]..... :					≥14.81					—	
Sample #	Measured				Dielectric breakdown					Result	
	MΩ				Yes (description)				No		
HA2023TL-0093-001X	>10000				No Dielectrical breakdown					x	P

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Clause	Requirement + Test	Result - Remark	Verdict	
HA2023TL-0093-004X	>10000	No Dielectrical breakdown	x	P
HA2023TL-0093-005X	>10000	No Dielectrical breakdown	x	P
HA2023TL-0093-006X	>10000	No Dielectrical breakdown	x	P
HA2023TL-0093-007X	>10000	No Dielectrical breakdown	x	P
HA2023TL-0093-008X	>10000	No Dielectrical breakdown	x	P
HA2023TL-0093-009X	>10000	No Dielectrical breakdown	x	P
HA2023TL-0093-010X	>10000	No Dielectrical breakdown	x	P
HA2023TL-0093-024X	>10000	No Dielectrical breakdown	x	P
HA2023TL-0093-025X	>10000	No Dielectrical breakdown	x	P
HA2023TL-0093-026X	>10000	No Dielectrical breakdown	x	P
HA2023TL-0093-027X	>10000	No Dielectrical breakdown	x	P
Supplementary information: The measurement limit of the equipment is 10000MΩ.				

TABLE 05: MQT 15 ini: Initial Wet leakage current test				P
Test Date [YYYY-MM-DD]		2023-02-06		—
Test Voltage applied [V]		1500		—
Solution temperature [°C]		22.4		—
Solution resistivity [Ω cm]		2305		—
Size of module [m²]		2.7		—
Sample #	Required Resistance [MΩ]	Measured [MΩ]	Result	
HA2023TL-0093-001X	≥14.81	5710	P	
HA2023TL-0093-004X	≥14.81	5110	P	
HA2023TL-0093-005X	≥14.81	3930	P	
HA2023TL-0093-006X	≥14.81	6740	P	
HA2023TL-0093-007X	≥14.81	5480	P	
HA2023TL-0093-008X	≥14.81	7250	P	
HA2023TL-0093-009X	≥14.81	6070	P	
HA2023TL-0093-010X	≥14.81	4160	P	

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Clause	Requirement + Test	Result - Remark	Verdict
HA2023TL-0093-024X	≥14.81	6310	P
HA2023TL-0093-025X	≥14.81	3780	P
HA2023TL-0093-026X	≥14.81	4290	P
HA2023TL-0093-027X	≥14.81	6260	P
Supplementary information:			

TABLE 06.1: MQT 07 - Performance at low irradiance (Front side)							P
Test Date [YYYY-MM-DD] :				2023-02-06			—
Test method ..:	☐ Outdoor measurement						—
	Ambient air temperature [°C]:						
	Irradiance [W/m²]:						
	Module temperature [°C]:						
	☒ Data corrected to a 25°C cell temperature and 200 W/m² irradiance						—
☐ Directly measured							
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	
HA2023TL-0093-001X	2.901	48.323	2.785	41.221	114.800	81.89	
Supplementary information:							

TABLE 06.2: MQT 07 - Performance at low irradiance (Back side)										—
Test Date [YYYY-MM-DD] :					—					—
Test method :	☐ Outdoor measurement									—
	Ambient air temperature [°C]:									
	Irradiance [W/m ²]:									
	Module temperature [°C]:									
	☐ Data corrected to a 25°C cell temperature and 200 W/m ² irradiance									—
☐ Directly measured										
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	ϕ _{Isc}	ϕ _{Voc}	ϕ _{Pmax}	
—	—	—	—	—	—	—	—	—	—	
Supplementary information:										

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Clause	Requirement + Test		Result - Remark	Verdict
TABLE 07: MQT 04 - Measurement of temperature coefficients				P
Test Date [YYYY-MM-DD]		2023-02-13		—
Ambient air temperature [°C] high/low		25		—
Irradiance [W/m²] high/low		1002.6/998.6		—
Module temperature [°C] high/low.....		55.3/25.0		—
Sample #	α [%/°C]	β [%/°C]	δ [%/°C]	—
HA2023TL-0093-001X	0.047	-0.235	-0.292	—
Supplementary information:				

TABLE 08: MQT 08 - Outdoor exposure test		P
Test Date [YYYY-MM-DD] start/end	2023-02-07/2023-03-04	—
Sample #	HA2023TL-0093-004X	
Total irradiation dosage [kWh/m²]	60.0	—
Angle of tilt the test module	37°±5°	—
Electrical load:	☐ Restive load ☒ MPPT	—
Supplementary information:		

Table 08.1: MQT 01: Visual inspection after outdoor exposure test			P
Test Date [YYYY-MM-DD]:		2023-03-04	—
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2023TL-0093-004X	No major visual defects found		P
Supplementary information:			

Table 08.2: MQT 15: Wet leakage current test after outdoor exposure test				P
Test Date [YYYY-MM-DD]	2023-03-04			—
Test Voltage applied [V]	1500			—
Solution temperature [°C]	22.3			—
Size of module [m ²]	2.7			—
Solution resistivity [Ω cm]	2141			—
Sample #	Measured [M Ω]	Limit [M Ω]	Result	
HA2023TL-0093-004X	4550	≥14.81		P
Supplementary information: Size of module 2.7[m ²]				

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Clause	Requirement + Test			Result - Remark		Verdict
Table 08.3: MQT 02 - Maximum power determination after outdoor exposure test - Optional						—
Test Date [YYYY-MM-DD]			—			—
Module temperature [°C].....			—			—
Irradiance [W/m²)			—			—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]
—	—	—	—	—	—	—
Supplementary information:						

Table 08.4: MQT 03 - Insulation test after outdoor exposure test - Optional					—
Test Date [YYYY-MM-DD].....:			—		—
Test Voltage applied [V]			—		—
Size of module [m²]			—		—
Required Resistance [MΩ].....:			—		—
Sample #	Measure d	Required (MΩ)	Dielectric breakdown		Result
	(MΩ)	(MΩ)	Yes (description)	No	
—	—	—	—	—	—
Supplementary information: Size of module [m²]					

TABLE 09: MQT 18: Bypass diode thermal test					P
Test Date [YYYY-MM-DD] start/end :		2023-04-25			—
Sample #		HA2023TL-0093-004X			—
Module temperature [°C]..... :		75±5			—
Number of diodes in junction box :		3			—
Diode manufacturer :		Zhejiang Twinsele Electronic Technology Co.,Ltd			—
Diode type designation :		SBRB3050TS			—
Max. permissible junction temperature Tjmax [°C] (according to diode datasheet) :		200			—
Detailed description of sample preparation procedure :		Standard preparation procedure			—
Step 1, Determination of VD versus TJ characteristic					—
		30 ± 2 °C	50 ± 2 °C	70 ± 2 °C	90 ± 2 °C
Ambient temperature of the junction box ... :		30.0	50.1	70.2	90.3
Pulsed current..... :		14.347	14.347	14.347	14.347

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Clause	Requirement + Test		Result - Remark		Verdict
Voltage drop [V]	0.4374 0.4305 0.4335	0.4182 0.4100 0.4144	0.4007 0.3921 0.3974	0.3818 0.3751 0.3775	
V _D versus T _J characteristic.....	Diode 1: V _D = -0.0009 T _J + 0.4648 Diode 2: V _D = -0.0009 T _J + 0.4572 Diode 3: V _D = -0.0009 T _J + 0.4612			—	
Max. permissible junction temperature T _{Jmax} [°C] (according to diode datasheet)	200			—	
Step 2, Bypass diode thermal test					
	Diode 1	Diode 2	Diode 3	Result	
Current flow applied [A]	14.347	14.347	14.347	—	
Max. diode surface temperature allowed T _{Jmax} [°C] :	200	200	200	—	
Voltage drop [V] after 1h	0.3328	0.3216	0.3339	—	
Calculated max. junction temperature T _{Jcalc} [°C]	146.676	150.707	141.495	—	
T _{Jcalc} < T _{Jmax} (test passed)? yes/no	yes	yes	yes	P	
Current flow (1.25 * I _{sc}) [A]	17.934	17.934	17.934	—	
Bypass diode remain(s) functional (yes/no)	yes	yes	yes	P	
Remarks: See Table 12 for the test details of bypass diode functionality test.					
3 Diodes are considered as representative number. These diodes have to be selected as worst case. In case that additional bypass diodes tests are performed the results shall be listed in an attachment.					

TABLE 09.1: MQT 01 - Visual inspection after bypass diode thermal test			P
Test Date [YYYY-MM-DD] :		2023-04-25	—
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2023TL-0093-004X	No major visual defects found		P
Supplementary information:			

TABLE 09.2: MQT 15 - Wet leakage current test after bypass diode thermal test			P
Test Date [YYYY-MM-DD]	2023-04-25		—
Test Voltage applied [V]	1500		—
Solution temperature [°C]	22.5		—
Size of module [m ²]	2.7		—
Solution resistivity [Ω cm]	2509		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2023TL-0093-004X	4720	≥14.81	P
Supplementary information:			

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 09.3: MQT 02 – Max. power determination after bypass diode thermal test - Optional							—
Test Date [YYYY-MM-DD]		—					—
Module temperature [°C]		—					—
Irradiance [W/m ²]		—					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	—
—	—	—	—	—	—	—	—
Supplementary information:							

TABLE 09.4: MQT 03 - Insulation test after bypass diode thermal test - Optional					—
Test Date [YYYY-MM-DD]		—			—
Test Voltage applied [V]		—			—
Size of module [m ²]		—			—
Required Resistance [MΩ]		—			—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
—	—	—	—	—	—
Supplementary information:					

TABLE 10: MQT 18.2 - Bypass diode functionality test after bypass diode thermal test					P
Test Date [YYYY-MM-DD]			2023-04-25		—
☐ Method A					—
Ambient temperature [°C]					—
Current flow applied [A]					—
Sample #	VFM	VFM _{rated}	VFM = (N × VFM _{rated}) ± 10 %		Result
			☐ Yes ☐ No		
Supplementary information:					
☒ Method B					—
	IV curve after shading				Result
Diode 1	Diode turn on				P
Diode 2	Diode turn on				P
Diode 3	Diode turn on				P
Supplementary information: Sample HA2023TL-0093-004X.					

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Clause	Requirement + Test				Result - Remark		Verdict
TABLE 10.1: MQT 19.1 Fin: Final stabilization							—
TABLE 10.2: MQT 06.1: Performance at STC before final stabilization							—
Test Date [YYYY-MM-DD]				—			—
Test method				☐ Simulator ☐ Natural sunlight			—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	—
—	—	—	—	—	—	—	—
Supplementary information:							

TABLE 10.3: MQT 19.1 Final Stabilization procedure								—
Light exposure method				☐ Simulator ☐ Natural sunlight				—
Stabilization criterion x per IEC 61215-1-x				—				—
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight								
Sample #	—	Test Date (YYYY-MM-DD) start/end				—		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)	
Initial	—	—	—	—		—	—	
1	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	
Supplementary information:								
☐ Other stabilization procedures								
Sample #	—	Test Date (YYYY-MM-DD) start/end				—		
Test method description:								
Supplementary information: See Annex 3 for verification of this alternative stabilization procedure								

TABLE 11: MQT 09 - Hot-spot endurance test						P
Test Date [YYYY-MM-DD] start/end				2023-04-27/2023-04-30		—
Sample #				HA2023TL-0093-004X		—
Procedure of technology				☒ wafer-based technologies (WBT) MQT 09.1 ☐ monolithically integrated (MLI) thin film technologies MQT 09.2		—
Cell interconnection circuit				☐ S ☒ SP ☐ PS		—

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Clause	Requirement + Test	Result - Remark	Verdict
Type of light source	☐ Pulse Simulator ☒ Steady state Simulator ☐ Natural sunlight		—
Module temperature at thermal equilibrium [°C] .:	55.3/55.9/54.8/56.2		—

TABLE 11.1: MQT 09 - Hot-spot endurance test for WBT						P
Selected hot-spot cells.....:	LOW	LOW	LOW	HIGH	Permanent	—
	—	—	—	—	—	—
Shading rate [%].....:	40	40	40	40	—	—
Max. measured cell temperature in each cell [°C] :	152.6	150.9	146.2	143.5	—	—
Test duration of each shading [h]	1	1	1	1	—	—
Irradiance during shading [W/m²]	1000	1000	1000	1000	—	—
Supplementary information: N/A						

TABLE 11.2: MQT 09 - Hot-spot endurance test for MLI		—
Selected hot-spot cells.....:	—	—
Number of cells shaded	—	—
Max. measured cell temperature [°C]	—	—
Test duration during shading [h]	—	—
Irradiance during shading [W/m²]	—	—
Supplementary information:		

TABLE 11.3: MQT 01 - Visual inspection after hot-spot endurance test		P
Test Date [YYYY-MM-DD].....:	2023-04-30	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2023TL-0093-004X	No major visual defects found	P
Supplementary information:		

TABLE 11.4: MQT 02 - Maximum power determination after hot-spot endurance test							P
Test Date [YYYY-MM-DD].....:	2023-04-30						—
Module temperature [°C].....:	25						—
Irradiance [W/m²]	1000						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	—
HA2023TL-0093-004X	14.320	51.221	13.634	42.894	584.832	79.73	P
Supplementary information:							

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 11.5: MQT 02 - Maximum power determination after hot-spot endurance test (at BNPI)							—
Test Date [YYYY-MM-DD]				—			—
Module temperature [°C]				—			—
Irradiance [W/m ²]				—			—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	—
—	—	—	—	—	—	—	—
Supplementary information:							

TABLE 11.6: MQT 03 - Insulation test after hot-spot endurance test					P
Test Date [YYYY-MM-DD]		2023-04-30			—
Test Voltage applied [V]		8000/1500			—
Size of module [m ²]		2.70			—
Required Resistance [MΩ]		≥14.81			—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
HA2023TL-0093-004X	>10000	≥14.81	No dielectric breakdown	X	P

TABLE 11.7: MQT 15 - Wet leakage current test after hot-spot endurance test			P
Test Date [YYYY-MM-DD]		2023-04-30	—
Test Voltage applied [V]		1500	—
Solution temperature [°C].....		22.0	—
Size of module [m²]		2.7	—
Solution resistivity [Ω cm].....		2292	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2023TL-0093-004X	4380	≥14.81	P
Supplementary information: Size of module 2.7[m²]			

TABLE 11.8: MQT 18.2 - Bypass diode functionality test after Hot-spot endurance test		P
Test Date [YYYY-MM-DD]	2023-04-30	—
☐ Method A		—
Ambient temperature [°C]		—
Current flow applied [A]		—

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Clause	Requirement + Test		Result - Remark	Verdict
Sample #	VFM	VFM _{rated}	VFM = (N × VFM _{rated}) ± 10 %	Result
			☐ Yes ☐ No	
Supplementary information:				
☒ Method B				—
	IV curve after shading			Result
Diode 1	Diode turn on			P
Diode 2	Diode turn on			P
Diode 3	Diode turn on			P
Supplementary information: Test sample: HA2023TL-0093-004X				

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Clause	Requirement + Test	Result - Remark	Verdict
TABLE 12.1: MQT 10 - UV preconditioning test (Front side)			P
Test Date (YYYY-MM-DD) start/end	2023-02-12/2023-02-17		—
Module temperature [°C]	60±5		—
UV irradiance (280-400nm) [W/m²]	140.6		—
UV dose (280-320nm) [kWh/ m²]	0.675		—
Module operation condition	☒ Short circuited ☐ Open circuited		—
Supplementary information: Total UV irradiation 15 kWh/m² in the wavelength range between 280 nm and 400 nm. 4.5% UV irradiation in the wavelength band between 280 nm and 320 nm.			

TABLE 12.2: MQT 10 - UV preconditioning test (Back side)			—
Test Date (YYYY-MM-DD) start/end	—		—
Module temperature [°C]	—		—
UV irradiance (280-400nm) [W/m²]	—		—
UV dose (280-320nm) [kWh/ m²]	—		—
Module operation condition	☐ Short circuited ☐ Open circuited		—
Supplementary information:			

TABLE 12.3: MQT 01 - Visual inspection after UV preconditioning test			P
Test Date [YYYY-MM-DD]	2023-02-17		—
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2023TL-0093-005X	No major visual defects found		P
HA2023TL-0093-006X	No major visual defects found		P

TABLE 12.4: MQT 15 - Wet leakage current test after UV preconditioning test			P
Test Date [YYYY-MM-DD]	2023-02-17		—
Test Voltage applied [V]	1500		—
Solution temperature [°C]	22.5		—
Solution resistivity [Ω cm]	2519		—
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
HA2023TL-0093-005X	4150	≥14.81	P
HA2023TL-0093-006X	6560	≥14.81	P
Supplementary information: Size of module 2.7[m²]			

TABLE 12.5: MQT 02 – Max. power determination after UV preconditioning test - Optional			—
Test Date [YYYY-MM-DD]	—		—

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Clause	Requirement + Test				Result - Remark		Verdict
Module temperature [°C].....:				—		—	
Irradiance [W/m²].....:				—		—	
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
Supplementary information:							

TABLE 12.6: MQT 03 - Insulation test after UV preconditioning test - Optional					—
Test Date [YYYY-MM-DD]			—		—
Test Voltage applied [V]			—		—
Size of module [m²]			—		—
Required Resistance [MΩ].....:			—		—
Sample #	Measured		Dielectric breakdown		Result
	[MΩ]		Yes (description)	No	
—	—	—	—	—	—
—	—	—	—	—	—
Supplementary information:					

TABLE 13: MQT 20 - Cyclic (dynamic) mechanical Load test		P
Test Date [MM/DD/YYYY].....:	2023-02-20/2023-02-24	—
Sample #	HA2023TL-0093-005X HA2023TL-0093-006X	—
Temperature of tested module(°C):	25	—
Maximum pressure (Pa) :	1000	—
Pressure tolerance(Pa) :	± 100	—
Monitoring current (A) :	0.14	—
Rate per minute(cycles) :	3/min	—
Number of cycles	1000	—
Pressure provider (Air pressure or vacuum).....:	Air pressure	—
Cell and alive part broken/ not	not	P
Current continuous (continuous/ disconnection occurred)	continuous	P
Supplementary information: ¼ long frame position by clamp installation		

TABLE 13.1: MQT 01 - Visual inspection after Cyclic (dynamic) mechanical Load test		P
Test Date [YYYY-MM-DD].....:	2023-02-24	—
Sample #	Nature and position of initial findings – comments or attach photos	—

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Clause	Requirement + Test	Result - Remark	Verdict
HA2023TL-0093-005X	No major visual defects found		P
HA2023TL-0093-006X	No major visual defects found		P
Supplementary information:			

TABLE 13.2: MQT 15 - Wet leakage current test after Cyclic (dynamic) mechanical Load test			P
Test Date [YYYY-MM-DD]	2023-02-24		—
Test Voltage applied [V]	1500		—
Solution temperature [°C]	22.2		—
Solution resistivity [Ω cm]	2519		—
Size of module [m ²]	2.7		—
Sample #	Measured [M Ω]	Required Resistance [M Ω]	Result
HA2023TL-0093-005X	4080	≥ 14.81	P
HA2023TL-0093-006X	6690	≥ 14.81	P
Supplementary information:			

TABLE 14: MQT 11 - Thermal cycling 50 test			P
Test Date [YYYY-MM-DD] start/end	2023-02-27/2023-03-07		—
Total cycles (50).....	50		—
Weight attached (N)	5		—
Applied current (A)	During the heat up cycle from -40 °C to 80 °C	13.759 for HA2023TL-0093-005X 13.773 for HA2023TL-0093-006X	—
	Other stages	0.03	—
Sample #	Open circuits (yes/no)		—
HA2023TL-0093-005X	No		P
HA2023TL-0093-006X	No		P
Supplementary information:			

TABLE 14.1: MQT 01 - Visual inspection after thermal cycling 50 test		P
Test Date [YYYY-MM-DD]	2023-03-07	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2023TL-0093-005X	No major visual defects found	P
HA2023TL-0093-006X	No major visual defects found	P
Supplementary information:		

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 14.2: MQT 15 - Wet leakage current test after thermal cycling 50 test			P
Test Date [YYYY-MM-DD]	2023-03-07		—
Test Voltage applied [V]	1500		—
Solution temperature [°C]	21.8		—
Solution resistivity [Ω cm]	2399		—
Size of module [m ²]	2.7		—
Sample #	Measured [M Ω]	Required Resistance [M Ω]	Result
HA2023TL-0093-005X	3750	≥ 14.81	P
HA2023TL-0093-006X	6230	≥ 14.81	P
Supplementary information:			

TABLE 14.3: MQT 03 – Max. power determination after thermal cycling 50 test - Optional							—
Test Date [YYYY-MM-DD]	—						—
Module temperature [°C]	—						—
Irradiance [W/m ²]	—						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
Supplementary information:							

TABLE 14.4: MQT 03 - Insulation test after thermal cycling 50 test - Optional					—
Test Date [YYYY-MM-DD]	—				—
Test Voltage applied [V]	—				—
Size of module [m ²]	—				—
Required Resistance [M Ω]	—				—
Sample #	Measured	Dielectric breakdown			Result
	[M Ω]	Yes (description)	No		
—	—	—	—	—	—
—	—	—	—	—	—
Supplementary information: Size of module [m ²]					

TABLE 15: MQT 12 - Humidity freeze 10 test		P
Test Date [YYYY-MM-DD] start/end	2023-03-14/2023-03-24	—
Total cycles (10)	10	—
Applied current (A)	0.03	—

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Clause	Requirement + Test	Result - Remark	Verdict
Sample #	Open circuits (yes/no)		—
HA2023TL-0093-005X	No		P
HA2023TL-0093-006X	No		P
Supplementary information:			

TABLE 15.1: MQT 01 - Visual inspection after humidity freeze 10 test		P
Test Date [YYYY-MM-DD]	2023-03-24	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2023TL-0093-005X	No major visual defects found	P
HA2023TL-0093-006X	No major visual defects found	P
Supplementary information:		

TABLE 15.2: MQT 15 - Wet leakage current test after humidity freeze 10 test			P
Test Date [YYYY-MM-DD]	2023-03-24		—
Test Voltage applied [V]	1500		—
Solution temperature [°C]	22.5		—
Size of module [m²]	2.7		—
Solution resistivity [Ω cm]	2445		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2023TL-0093-005X	3530	≥14.81	P
HA2023TL-0093-006X	6370	≥14.81	P
Supplementary information: Size of module 2.7[m²]			

TABLE 15.3: MQT 02 - Maximum power determination after humidity freeze 10 test -Optional							—
Test Date [YYYY-MM-DD]	—						—
Module temperature [°C]	—						—
Irradiance [W/m²]	—						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
Supplementary information:							

TABLE 15.4: MQT 03 Insulation test after humidity freeze 10 test) -Optional			—
Test Date [YYYY-MM-DD]	—		—
Test Voltage applied [V]	—		—

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Clause	Requirement + Test			Result - Remark	Verdict
Size of module [m ²]			—		—
Required Resistance [MΩ]			—		—
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
—	—	—	—	—	—
—	—	—	—	—	—
Supplementary information: Size of module [m ²]					

TABLE 16: MQT 14.1 Retention of junction box on mounting surface		P
Test Date [YYYY-MM-DD] start/end: 2023-03-25		—
Sample #	HA2023TL-0093-005X	—
Supplementary information: Pull force is 40N.		

TABLE 16.1: MQT 01 - Visual inspection after retention of junction box on mounting surface		P
Test Date [YYYY-MM-DD]: 2023-03-25		—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2023TL-0093-005X	No major visual defects found	P
Supplementary information:		

TABLE 16.2: MQT 15 - Wet leakage current test after retention of junction box on mounting surface			P
Test Date [YYYY-MM-DD]..... :		2023-03-25	—
Test Voltage applied [V] :		1500	—
Solution temperature [°C].....:		21.6	—
Size of module [m²]		2.7	—
Solution resistivity [Ω cm]..... :		2270	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2023TL-0093-005X	4090	≥14.81	P
Supplementary information: Size of module 2.7[m²]			

TABLE 17: MQT 11 - Thermal cycling 200 test					P
Test Date [YYYY-MM-DD] start/end			2023-02-09/2023-03-14		—
Total cycles (200)			200		—
Weight attached (N)			5		—

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Clause	Requirement + Test	Result - Remark	Verdict
Applied current (A)	During the heat up cycle from −40 °C to 80 °C	13.765A for HA2023TL-0093-009X. 13.699A for HA2023TL-0093-010X.	—
	Other stages	0.03	—
Sample #	Open circuits (yes/no)		—
HA2023TL-0093-009X	no		P
HA2023TL-0093-010X	no		P
Supplementary information:			

TABLE 17.1: MQT 01 - Visual inspection after thermal cycling 200 test		P
Test Date [YYYY-MM-DD]	2023-03-14	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2023TL-0093-009X	No major visual defects found	P
HA2023TL-0093-010X	No major visual defects found	P
Supplementary information:		

TABLE 17.2: MQT 15 - Wet leakage current test after thermal cycling 200 test			P
Test Date [YYYY-MM-DD]	2023-03-14		—
Test Voltage applied [V]	1500		—
Solution temperature [°C]	21.4		—
Size of module [m²]	2.7		—
Solution resistivity [Ω cm]	2417		—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2023TL-0093-009X	5640	≥14.81	P
HA2023TL-0093-010X	3960	≥14.81	P
Supplementary information: Size of module [m²]			

TABLE 18: MQT 13 - Damp heat 1000 test		P
Test Date [YYYY-MM-DD] start/end	2023-02-07/2023-03-21	—
Total hours (1000h)	1000	—
Sample #		—
HA2023TL-0093-007X	No	P
HA2023TL-0093-008X	No	P
Supplementary information:		

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Clause	Requirement + Test	Result - Remark	Verdict
TABLE 18.1: MQT 01 - Visual inspection after damp heat 1000 test			P
Test Date [YYYY-MM-DD]:		2023-03-21	—
Sample #	Nature and position of initial findings – comments or attach photos		—
HA2023TL-0093-007X	No major visual defects found		P
HA2023TL-0093-008X	No major visual defects found		P
Supplementary information:			

TABLE 18.2: MQT 15 - Wet leakage current test after damp heat 1000 test			P
Test Date [YYYY-MM-DD]		2023-03-21	—
Test Voltage applied [V]		1500	—
Solution temperature [°C]		21.9	—
Size of module [m²]		2.7	—
Solution resistivity [Ω cm]		2208	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2023TL-0093-007X	5030	≥14.81	P
HA2023TL-0093-008X	6920	≥14.81	P
Supplementary information: Size of module 2.7[m²]			

TABLE 18.3: MQT 02 - Maximum power determination after damp heat 1000 test - Optional							—
Test Date [YYYY-MM-DD]		—					—
Module temperature [°C]		—					—
Irradiance [W/m²]		—					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
Supplementary information:							

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Clause	Requirement + Test	Result - Remark	Verdict

TABLE 18.4: MQT 03 - Insulation test after damp heat 1000 test - Optional					—
Test Date [YYYY-MM-DD]		—			—
Test Voltage applied [V]		—			—
Size of module [m ²]		—			—
Sample #	Measured	Required Resistance	Dielectric breakdown		Result
	[MΩ]	[MΩ]	Yes (description)	No	
—	—	—	—	—	—
—	—	—	—	—	—
Supplementary information: Size of module [m ²]					

TABLE 19: MQT 16 Static mechanical load test				P
Sample # :		HA2023TL-0093-007X		—
Design load(front side/ back side).....		3600/1600		—
Safety factors		1.5		—
Test Date [YYYY-MM-DD]		2023-03-22		—
Mounting method		According to user manual		—
Load applied to.....		front side	back side	—
Mechanical load [Pa].....		5400	2400	—
First cycle time (start/end).....		08:20/09:20	09:40/10:40	—
Intermittent open-circuit (yes/no)		no	no	P
Second cycle time (start/end)		11:05/12:05	12:20/13:20	—
Intermittent open-circuit (yes/no)		no	no	P
Third cycle time (start/end)		13:45/14:45	15:00/16:00	—
Intermittent open-circuit (yes/no)		no	no	P
Supplementary information: ¼ long frame position by clamp installation				

TABLE 19.1: MQT 01 - Visual inspection after static mechanical load test		P
Test Date [YYYY-MM-DD]: 2023-03-22		—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2023TL-0093-007X	No major visual defects found	P
Supplementary information:		

TABLE 19.2: MQT 15 - Wet leakage current test after static mechanical load test		P
Test Date [YYYY-MM-DD]		2023-03-22

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Clause	Requirement + Test	Result - Remark	Verdict
Test Voltage applied [V]		1500	—
Solution temperature [°C]		21.7	—
Size of module [m ²]		2.7	—
Solution resistivity [Ω cm]		2459	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2023TL-0093-007X	4910	≥14.81	P
Supplementary information:			

TABLE 20: MQT 22 Bending test			—
Test Date [YYYY-MM-DD]		—	—
Sample # :		—	—
Specified radius of curvature		—	—
Bending radius		—	—
Total cycles		—	—
Intermittent open-circuit (yes/no)		—	—
Supplementary information: may need to be performed with each mounting situation			

TABLE 20.1: MQT 01 - Visual inspection after bending test		—
Test Date [YYYY-MM-DD].....:		—
Sample #	Nature and position of initial findings – comments or attach photos	—
—	—	—
Supplementary information:		

TABLE 20.2: MQT 15 - Wet leakage current test after bending test			—
Test Date [YYYY-MM-DD]		—	—
Test Voltage applied [V]		—	—
Solution temperature [°C]		—	—
Size of module [m ²]		—	—
Solution resistivity [Ω cm]		—	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
—	—	—	—
Supplementary information:			

TABLE 21: MQT 17 - Hail impact test			P
Test Date [YYYY-MM-DD]		2023-03-23	—
Sample #		HA2023TL-0093-008X	—

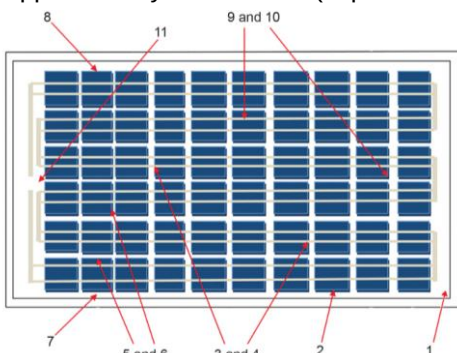
IEC 61215-2							
Clause	Requirement + Test				Result - Remark		Verdict
Ice ball size [mm] :	1	2	3	4	5	6	—
	25.5	24.4	24.5	25.4	24.7	24.3	
	7	8	9	10	11	/	
	24.9	25.1	25.0	25.2	25.9	/	
Ice ball weight [g] :	1	2	3	4	5	6	—
	7.70	7.25	7.78	7.58	7.78	7.45	
	7	8	9	10	11	/	
	7.38	7.45	7.56	7.79	7.81	/	
Ice ball velocity [m/s] :	1	2	3	4	5	6	—
	22.5	22.6	22.7	22.8	23.1	22.5	
	7	8	9	10	11	/	
	22.8	23.0	22.8	23.4	22.7	/	
Number of impact locations :	11						—
Supplementary information: (impact location descriptions)							
							

TABLE 21.1: MQT 01 - Visual inspection after hail impact test		P
Test Date [YYYY-MM-DD]	2023-03-23	—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2023TL-0093-008X	No major visual defects found	P
Supplementary information:		

TABLE 21.2: MQT 15 - Wet leakage current test after hail impact test			P
Test Date [YYYY-MM-DD]	2023-03-23		—
Test Voltage applied [V]	1500		—
Solution temperature [°C]	22.4		—
Solution resistivity [Ω cm]	2.7		—
Size of module [m ²]	2509		—

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Clause	Requirement + Test	Result - Remark	Verdict
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
HA2023TL-0093-008X	6740	≥14.81	P
Supplementary information:			

TABLE 22: MQT 15 -Potential induced degradation test		P
Test Date [MM/DD/YYYY] start/end..... :	2023-03-01/2023-03-06	—
Chamber air temperature (°C) :	85	—
Chamber relative humidity (% RH) :	85	—
Test duration hours (h) :	96	—
Sample #	Applied voltage stress (V) and polarities	—
HA2023TL-0093-024X	+1500	P
HA2023TL-0093-025X	+1500	P
HA2023TL-0093-026X	-1500	P
HA2023TL-0093-027X	-1500	P
Supplementary information: Dwell times 96 hours at the above stated temperature and relative humidity (not including stabilization).Method (a) according to IEC TS62804-1:2015		

TABLE 22.1: MQT 01 - Visual inspection after potential induced degradation test		P
Test Date [YYYY-MM-DD]: 2023-03-06		—
Sample #	Nature and position of initial findings – comments or attach photos	—
HA2023TL-0093-024X	No major visual defects found	P
HA2023TL-0093-025X	No major visual defects found	P
HA2023TL-0093-026X	No major visual defects found	P
HA2023TL-0093-027X	No major visual defects found	P
Supplementary information:		

TABLE 22.2: MQT 15 - Wet leakage current test after potential induced degradation test			P
Test Date [YYYY-MM-DD]	2023-03-06		—
Test Voltage applied [V]	1500		—
Solution temperature [°C]	22.2		—
Solution resistivity [Ω cm]	2.7		—
Size of module [m²]	2591		—
Sample #	Measured [MΩ]	Required Resistance [MΩ]	Result
HA2023TL-0093-024X	6130	≥14.81	P
HA2023TL-0093-025X	3590	≥14.81	P

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Clause	Requirement + Test	Result - Remark	Verdict
HA2023TL-0093-026X	4140	≥14.81	P
HA2023TL-0093-027X	6350	≥14.81	P
Supplementary information:			

TABLE 23: MQT 19.2 Fin: Final stabilization							—
TABLE 23.1: MQT 06.1: Performance at STC before final stabilization							—
Test Date [YYYY-MM-DD]				—			—
Test method				☐ Simulator ☐ Natural sunlight			—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
Supplementary information:							

TABLE 23.2: MQT 19.1 Final Stabilization procedure							—
☐ IEC 61215-1-2 ☐ IEC 61215-1-3 ☐ IEC 61215-1-4							—
Light exposure method:				☐ Simulator			☐ Natural sunlight
Stabilization criterion x per IEC 61215-1-x :				—			
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Sample #		Test Date (YYYY-MM-DD) start/end..:			—		
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Sample #		Test Date (YYYY-MM-DD) start/end			—		

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Clause	Requirement + Test				Result - Remark		Verdict
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Sample #		Test Date (YYYY-MM-DD) start/end			—		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Sample #		Test Date (YYYY-MM-DD) start/end..:			—		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Sample #		Test Date (YYYY-MM-DD) start/end			—		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Sample #		Test Date (YYYY-MM-DD) start/end.....:			—		

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Clause	Requirement + Test				Result - Remark	Verdict	
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Sample #	Test Date (YYYY-MM-DD) start/end				—		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—
Supplementary information:							
☐ Other stabilization procedures							
Sample #	Test Date (YYYY-MM-DD) start/end						
—	—						
—	—						
—	—						
—	—						
—	—						
—	—						
—	—						
Test method description:							
Supplementary information: see Annex 3 for verification of this alternative stabilization procedure							

TABLE 23.3: MQT 19.2 Fin: Final stabilization		—
☐ IEC 61215-1-1		—
☐ Method 1		—
Stress-specific stabilization – BO LID (MQT 19.3)		—
Test Date [YYYY-MM-DD]	—	—
Applied current (A)	—	—
Module temperature [°C]	—	—
Total hours (48h)	—	—

IEC 61215-2									
Clause	Requirement + Test						Result - Remark	Verdict	
Performance at STC after final stabilization— for monofacial modules									
Test Date [YYYY-MM-DD]				—					—
Test method				☐ Simulator ☐ Natural sunlight					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation	Result
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
Performance at BNPI after final stabilization — for bifacial modules									—
Test Date [YYYY-MM-DD]				—					—
Test method				☐ Simulator ☐ Natural sunlight					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation	Result
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
Supplementary information:									
☒ Method 2									P
Performance at STC before final stabilization— for monofacial modules									—
Test Date [YYYY-MM-DD]				2023-03-24					—
Test method				☒ Simulator ☐ Natural sunlight					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation	Result
HA2023TL-0093-007X	14.047	51.131	13.386	42.900	574.254	79.95	588.687	-2.45	P
HA2023TL-0093-008X	14.091	51.100	13.402	42.899	574.930	79.84	590.511	-2.64	P
Performance at BNPI before final stabilization — for bifacial modules									—
Test Date [YYYY-MM-DD]				—					—
Test method				☐ Simulator ☐ Natural sunlight					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation	Result
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—

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Clause	Requirement + Test						Result - Remark	Verdict	
Supplementary information: This module was not stabilized, and therefore the amount of degradation observed may be larger than what would have been obtained if the module had been stabilized, due to destabilization artifacts.									
If Power Degradation $\geq 5\%$, then perform stress-specific stabilization MQT 19.3 in method 1									
Stress-specific stabilization – BO LID (MQT 19.3)									—
Test Date [YYYY-MM-DD]				—				—	
Applied current (A)				—				—	
Module temperature [°C]				—				—	
Total hours (48h)				—				—	
Performance at STC after final stabilization — for monofacial modules									
Test Date [YYYY-MM-DD]				—				—	
Test method				☐ Simulator ☐ Natural sunlight				—	
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation	Result
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
Performance at BNPI after final stabilization — for bifacial modules									—
Test Date [YYYY-MM-DD]				—				—	
Test method				☐ Simulator ☐ Natural sunlight				—	
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation	Result
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
Supplementary information:									
TABLE 23.4: MQT 19.2 Fin: Final stabilization									—
☐ Method 3									—
Test Date (YYYY-MM-DD) start/end				—				—	
Test duration (h)				—				—	
Module temperature [°C]				—				—	
UV irradiance (280-400nm) [W/m²]				—				—	
UV dose (280-320nm) [kWh/ m²]				—				—	
UV dose (280-400nm) [kWh/ m²]				—				—	
Side exposed				☐ Front side ☐ Rear side				—	
Module operation condition				☐ Short circuited ☐ Open circuited				—	

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Clause	Requirement + Test						Result - Remark	Verdict		
Supplementary information: For bifacial modules, the irradiance shall be applied to the rear side, whereas for monofacial modules, the irradiance shall be applied to the front side.										
Performance at STC after final stabilization— for monofacial modules									—	
Test Date [YYYY-MM-DD]				—						—
Test method				☐ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation	Result	
—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	
Performance at BNPI after final stabilization — for bifacial modules									—	
Test Date [YYYY-MM-DD]				—						—
Test method				☐ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation	Result	
—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	
Supplementary information:										
☒ Method 4									P	
Performance at STC before final stabilization— for monofacial modules									—	
Test Date [YYYY-MM-DD]				2023-03-06						—
Test method				☒ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation	Result	
HA2023TL-0093-024X	14.225	51.203	13.599	43.214	587.672	80.68	592.274	-0.78	P	
HA2023TL-0093-025X	14.244	51.153	13.577	43.241	587.072	80.57	591.460	-0.74	P	
HA2023TL-0093-026X	14.116	51.382	13.507	43.213	583.692	80.48	590.183	-1.10	P	
HA2023TL-0093-027X	14.103	51.193	13.536	42.903	580.742	80.44	590.454	-1.64	P	

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Clause	Requirement + Test						Result - Remark	Verdict	
Performance at BNPI before final stabilization — for bifacial modules									—
Test Date [YYYY-MM-DD]				—					—
Test method				☐ Simulator ☐ Natural sunlight					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation	Result
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
Supplementary information: This module was not stabilized, and therefore the amount of degradation observed may be larger than what would have been obtained if the module had been stabilized, due to polarization artifacts									
If Power Degradation ≥ 5%, then perform method 3 final stabilization									
Method 3									—
Test Date [YYYY-MM-DD]				—					—
Test duration (h)				—					—
Module temperature [°C]				—					—
UV irradiance (280-400nm) [W/m²]				—					—
UV dose (280-320nm) [kWh/ m²]				—					—
UV dose (280-400nm) [kWh/ m²]				—					—
Side exposed				☐ Front side ☐ Rear side					—
Module operation condition				☐ Short circuited ☐ Open circuited					—
Performance at STC after final stabilization — for monofacial modules									
Test Date [YYYY-MM-DD]				—					—
Test method				☐ Simulator ☐ Natural sunlight					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation	Result
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
Performance at BNPI after final stabilization — for bifacial modules									—
Test Date [YYYY-MM-DD]				—					—

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Clause	Requirement + Test					Result - Remark			Verdict
Test method :				☐ Simulator ☐ Natural sunlight					—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab _GateNo.1)	Power Degradation	Result
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
Supplementary information:									

TABLE 23.5: MQT 06.1: Final Performance at STC									P
Test Date [YYYY-MM-DD]					2023-03-24				—
Test method					☒ Simulator		☐ Natural sunlight		—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab_Gate No.1)	Power Degradation [%]	Result
HA2023TL-0093-001X	14.322	51.336	13.673	43.215	590.905	80.37	589.828	+0.18	P
HA2023TL-0093-005X	14.240	51.072	13.578	42.892	582.389	80.08	590.399	-1.36	P
HA2023TL-0093-006X	14.274	51.110	13.586	42.843	582.056	79.78	589.888	-1.33	P
HA2023TL-0093-007X	14.047	51.131	13.386	42.900	574.254	79.95	588.687	-2.45	P
HA2023TL-0093-008X	14.091	51.100	13.402	42.899	574.930	79.84	590.511	-2.64	P
HA2023TL-0093-009X	14.260	51.234	13.627	43.015	586.175	80.23	592.827	-1.12	P
HA2023TL-0093-010X	14.271	51.135	13.598	43.002	584.719	80.13	590.277	-0.94	P
HA2023TL-0093-024X	14.225	51.203	13.599	43.214	587.672	80.68	592.274	-0.78	P
HA2023TL-0093-025X	14.244	51.153	13.577	43.241	587.072	80.57	591.460	-0.74	P
HA2023TL-0093-026X	14.116	51.382	13.507	43.213	583.692	80.48	590.183	-1.10	P
HA2023TL-0093-027X	14.103	51.193	13.536	42.903	580.742	80.44	590.454	-1.64	P
Supplementary information: Pmax [W] (Lab_GateNo.1) is calculated by considering the reproducibility <i>r</i> of control module (reproducibility <i>r</i> is 0.23%).									

For bifacial modules									—
TABLE 23.6: MQT 06.1 ini: Performance at STC after final stabilization (Front side)									—
Test Date [YYYY-MM-DD]					—				—

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Clause	Requirement + Test							Result - Remark		Verdict
Test method				☐ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result			
—	—	—	—	—	—	—	—			
—	—	—	—	—	—	—	—			
—	—	—	—	—	—	—	—			
—	—	—	—	—	—	—	—			
Supplementary information:										
TABLE 23.7: MQT 06.1 ini: Performance at STC after final stabilization(Back side)										—
Test Date [YYYY-MM-DD]				—						—
Test method				☐ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	ϕ_{Isc}	ϕ_{Voc}	ϕ_{Pmax}	Result
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
Supplementary information:										

TABLE 23.8: MQT 06.1: Final Performance at BNPI										—
Test Date [YYYY-MM-DD]				—						—
Test method				☐ Simulator ☐ Natural sunlight						—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Pmax [W] (Lab_GateNo.1)	Power Degradation [%]	Result	
—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	
Supplementary information: Pmax [W] (Lab_GateNo.1) is calculated by considering the reproducibility <i>r</i> of control module.										

TABLE 23.9: MQT 03 fin: Final Insulation test		P
Test Date [YYYY-MM-DD]	2023-03-24	—
Test Voltage applied [V]	8000/1500	—

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Clause	Requirement + Test		Result - Remark		Verdict
Size of module [m²] :			2.7		—
Sample #	Required	Measured	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
HA2023TL-0093-001X	≥14.81	>10000	No Dielectrical breakdown	X	P
HA2023TL-0093-005X	≥14.81	>10000	No Dielectrical breakdown	X	P
HA2023TL-0093-006X	≥14.81	>10000	No Dielectrical breakdown	X	P
HA2023TL-0093-007X	≥14.81	>10000	No Dielectrical breakdown	X	P
HA2023TL-0093-008X	≥14.81	>10000	No Dielectrical breakdown	X	P
HA2023TL-0093-009X	≥14.81	>10000	No Dielectrical breakdown	X	P
HA2023TL-0093-010X	≥14.81	>10000	No Dielectrical breakdown	X	P
HA2023TL-0093-024X	≥14.81	>10000	No Dielectrical breakdown	X	P
HA2023TL-0093-025X	≥14.81	>10000	No Dielectrical breakdown	X	P
HA2023TL-0093-026X	≥14.81	>10000	No Dielectrical breakdown	X	P
HA2023TL-0093-027X	≥14.81	>10000	No Dielectrical breakdown	X	P
Supplementary information: The measurement limit of the equipment is 10000MΩ.					

TABLE 23.10: MQT 15 fin: Final Wet leakage current test			P
Test Date [YYYY-MM-DD] :		2023-03-24	—
Test Voltage applied [V] :		1500	—
Solution temperature [°C] :		22.2	—
Size of module [m ²] :		2.7	—
Solution resistivity [Ω cm] :		2299	—
Sample #	Measured [MΩ]	Limit [MΩ]	Result
HA2023TL-0093-001X	5930	≥14.81	P
HA2023TL-0093-005X	4160	≥14.81	P
HA2023TL-0093-006X	6110	≥14.81	P
HA2023TL-0093-007X	5150	≥14.81	P
HA2023TL-0093-008X	6640	≥14.81	P

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Clause	Requirement + Test	Result - Remark	Verdict
HA2023TL-0093-009X	5830	≥ 14.81	P
HA2023TL-0093-010X	4290	≥ 14.81	P
HA2023TL-0093-024X	6130	≥ 14.81	P
HA2023TL-0093-025X	3590	≥ 14.81	P
HA2023TL-0093-026X	4140	≥ 14.81	P
HA2023TL-0093-027X	6350	≥ 14.81	P
Supplementary information:			

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Annex 1-1: Product Description Sheet (Manufacturers and type references)

Item1

A1.1	MODULE TYPE/S
	a) RSM144-10-xxxN, xxx= 575 to 615 in step of 5, b) RSM120-10-xxxN, xxx= 480 to 505 in step of 5, c) RSM108-10-xxxN, xxx= 430 to 460 in step of 5 xxx is standing for rated output power at STC

A1.2	MODULE DESIGN
	Module dimensions (L x W x H) [mm]: a) 2382 x 1134 x 30 b) 1994 x 1134 x 30 c) 1800 x 1134 x 30
	Weights.....: a) 30.0 kg (approx) b) 25.0 kg (approx) c) 22.0 kg (approx)
	Front/Rear cover bonding classification: ☒ rigid/flexible ☐ rigid/rigid ☐ flexible/flexible

A1.3	SOLAR CELL
	Cell type reference: Risen Energy Co., Ltd. Mono-Si, N-type, Bifacial TOPCon Cell , Cell type: RSTCS192B(16BB), ½ cut cell.
	Cell dimensions L x W x T (± %) [mm]: 182.2 × 96 ± 3
	Cell thickness [μm]: 130 ± 13
	Cell area [cm²]: 174.19 ± 5.61

A1.4	IDENTIFICATION OF MATERIALS
	Front cover.....: Flat Glass Group Co., Ltd. Type: Coating tempered glass, Thickness: 3.2 mm
	Rear cover: Crown Advanced Material Co.,Ltd. Model: Crown BO-L3, Material: PET(air side)(White)/adhesive/PO(Cell side) (white), Thickness: 165/10/185.total 360um. Color: White
	Encapsulation material front side: Zhejiang Sinopont Technology Co., Ltd. Type: PO8110 (close to glass). Material: POE. Thickness: 0.50mm.

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	Encapsulation material back side	Zhejiang Sinopont Technology Co., Ltd. Type: 7100 (close to backsheet).Material: EVA. Thickness: 0.50mm.
	Frame parts	Risen (Ningbo) New Material Co.,Ltd. Anodized aluminum alloy, type: 6005 T6 assembled by key corners. Thickness: 30mm
	Mounting parts	N/A
	Adhesive for frame	Hangzhou Zhijiang Silicone Chemicals CO., LTD. Type: JS-606
	Edge sealing	N/A
	Internal wiring	N/A
	Cell connector	Risen (Ningbo) New Material Co.,Ltd. Base Cu (TU1),Purity≥99.97%.Coating: Sn60Pb40.Cross section: Φ 0.25 mm Singleside coating thickness:17 μm
	String connector	Risen (Ningbo) New Material Co.,Ltd. Base Cu (TU1).Purity ≥99.97%. Coating: Sn60Pb40.Cross section: 4 x 0.25 mm / 4 x 0.40 mm Average tin layer thickness on the welding surface:23 μm
	Soldering material	N/A
	Fluxing agent	ASAHI SOLDER Type: SF105
	Junction box	Zhejiang Twinsel Electronic Technology Co.,Ltd. Type: PV-SY017, DC 1500 V, 20 A, IP 68, -40 °C to 85 °C
	Cable	Zhejiang Twinsel Electronic Technology Co.,Ltd. Type:62930 IEC131 1×4mm ² , DC1500V, -40 °C to 90 °C (Type: H1Z2Z2-K, 1×4mm ² , DC 1500V, -40 °C to 90 °C)
	Connector	Zhejiang Twinsel Electronic Technology Co.,Ltd. Type PV-SY02, DC 1500 V,30 A, IP 68, -40 °C to 85 °C.
	Bypass diode	Zhejiang Twinsel Electronic Technology Co.,Ltd. Schottky, Type: SBRB3050TS, Max. peak reverse voltage 50 V, Forward Rectified current 30 A. Max junction temperature 200 °C(t ≤ 1 h)

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	Potting material.....:	Hangzhou Zhijiang Silicone Chemicals CO., LTD. Type: JS-1184
	Adhesive for junction box	Hangzhou Zhijiang Silicone Chemicals CO., LTD. Type: JS-606
	Additional material (e. g. fixing tape, insulation tape).....:	Fixing tape: Huizhou Zhikuan Technology Co.,Ltd. Special acrylic adhesive, PET substrate, Type:HZ UV-100 Label: Seaprinting Changzhou CO., LTD. Type: Seaprinting-TC-04, Asian Silver PET (AVERY 50 micron Matte silver PET TC/S333BG50#WH imp)

A1.5	MODULE DESIGN - MINIMUM DISTANCES	
	Between cells.....:	0.81 mm
	Between cell and accessible surfaces.....:	10.4 mm
	Between any current carrying part and accessible surfaces	10.4 mm

A1.6	MODULE DESIGN - ELECTRICAL CONFIGURATION	
	Total number of cells	a) 144 b) 120 c) 108
	Serial-parallel connection of cells	a) 72/2 b) 60/2 c) 54/2
	Cells per bypass diode	a) 48/48/48 b) 40/40/40 c) 36/36/36
	No. of bypass diodes	a) 3 diodes b) 3 diodes c) 3 diodes

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Annex 1-2: Product Description Sheet (Manufacturers and type references)

Item2

A1.1	MODULE TYPE/S
	d) RSM144-9-xxxN, xxx= 555 to 590 in steps of 5 e) RSM120-9-xxxN, xxx= 460 to 490 in steps of 5 f) RSM108-9-xxxN, xxx= 415 to 440 in steps of 5 xxx is standing for rated output power at STC

A1.2	MODULE DESIGN
	Module dimensions (L x W x H) [mm] : d) 2278 x 1134 x 30 e) 1903 x 1134 x 30 f) 1722 x 1134 x 30
	Weights..... : d) 27.0 kg (approx) e) 23.5 kg (approx) f) 20.5 kg (approx)
	Front/Rear cover bonding classification : ☒ rigid/flexible ☐ rigid/rigid ☐ flexible/flexible

A1.3	SOLAR CELL
	Cell type reference : Risen Energy Co., Ltd. Mono-Si, N-type, Bifacial Topcon Cell , Cell type: RSTCS182B(16BB), ½ cut cell.
	Cell dimensions L x W x T (± %) [mm] : 182.2 × 91 ± 3
	Cell thickness [μm] : 130 ± 13
	Cell area [cm²] : 165.08 ± 5.46

A1.4	IDENTIFICATION OF MATERIALS
	Front cover..... : Flat Glass Group Co., Ltd. Type: Coating tempered glass, Thickness: 3.2 mm
	Rear cover : Crown Advanced Material Co.,Ltd. Model: Crown BO-L3, Material: PET(air side)(White)/adhesive/PO(Cell side) (white), Thickness: 165/10/185.total 360um. Color: White
	Encapsulation material front side : Zhejiang Sinopont Technology Co., Ltd. Type: PO8110 (close to glass). Material: POE. Thickness: 0.50mm.
	Encapsulation material back side : Zhejiang Sinopont Technology Co., Ltd. Type: 7100 (close to backsheet).Material: EVA. Thickness: 0.50mm.

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	Frame parts	Risen (Ningbo) New Material Co.,Ltd. Anodized aluminum alloy, type: 6005 T6 assembled by key corners. Thickness: 30mm
	Mounting parts	N/A
	Adhesive for frame	Hangzhou Zhijiang Silicone Chemicals CO., LTD. Type: JS-606
	Edge sealing	N/A
	Internal wiring	N/A
	Cell connector	Risen (Ningbo) New Material Co.,Ltd. Base Cu (TU1),Purity≥99.97%.Coating: Sn60Pb40.Cross section:Φ 0.25 mm Singleside coating thickness:17 μm
	String connector	Risen (Ningbo) New Material Co.,Ltd. Base Cu (TU1).Purity ≥99.97%. Coating: Sn60Pb40.Cross section: 4 x 0.25 mm / 4 x 0.40 mm. Average tin layer thickness on the welding surface: 23 μm
	Soldering material.....	N/A
	Fluxing agent	ASAHI SOLDER Type: SF105
	Junction box.....	Zhejiang Twinsel Electronic Technology Co.,Ltd. Type: PV-SY017, DC 1500 V, 20 A, IP 68, -40 °C to 85 °C
	Cable	Zhejiang Twinsel Electronic Technology Co.,Ltd. Type:62930 IEC131 1×4mm ² , DC1500V, -40 °C to 90 °C (Type: H1Z2Z2-K, 1×4mm ² , DC 1500V, -40 °C to 90 °C)
	Connector	Zhejiang Twinsel Electronic Technology Co.,Ltd. Type PV-SY02, DC 1500 V,30 A, IP 68, -40 °C to 85 °C.
	Bypass diode	Zhejiang Twinsel Electronic Technology Co.,Ltd. Schottky, Type: SBRB3050TS, Max. peak reverse voltage 50 V, Forward Rectified current 30 A. Max junction temperature 200 °C(t ≤ 1 h)
	Potting material.....	Hangzhou Zhijiang Silicone Chemicals CO., LTD. Type: JS-1184

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	Adhesive for junction box	Hangzhou Zhijiang Silicone Chemicals CO., LTD. Type: JS-606
	Additional material (e. g. fixing tape, insulation tape).....	Fixing tape: Huizhou Zhikuan Technology Co.,Ltd. Special acrylic adhesive, PET substrate, Type:HZ UV-100 Label: Seaprinting Changzhou CO., LTD. Type: Seaprinting-TC-04, Asian Silver PET (AVERY 50 micron Matte silver PET TC/S333BG50#WH imp)

A1.5	MODULE DESIGN - MINIMUM DISTANCES	
	Between cells.....	1.08 mm
	Between cell and accessible surfaces.....	10.4 mm
	Between any current carrying part and accessible surfaces	10.4 mm

A1.6	MODULE DESIGN - ELECTRICAL CONFIGURATION	
	Total number of cells	a) 144 b) 120 c) 108
	Serial-parallel connection of cells	a) 72/2 b) 60/2 c) 54/2
	Cells per bypass diode	a) 48/48/48 b) 40/40/40 c) 36/36/36
	No. of bypass diodes	a) 3 diodes b) 3 diodes c) 3 diodes

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Clause	Requirement + Test	Result - Remark	Verdict

Annex 2: Test table for verifying other alternative stabilization procedure

Step 1: Alternative stabilization									
Test Date (YYYY-MM-DD) start/end:									—
Test method description:									—
	Sample	Sample	Sample						—
Power before alternative stabilization (W)									—
Power after alternative stabilization (W)									—
Supplementary information:									
Step 2: Light exposure									
☐ Simulator ☐ Natural sunlight									
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight									
Sample		Test Date (YYYY-MM-DD) start/end.....:							
Test cycle	Light source	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)	
Initial	—	—	—	—	—		—	—	
1							—	—	
2									
Supplementary information:									
Sample		Test Date (YYYY-MM-DD) start/end.....:							
Test cycle	Light source	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)	
Initial	—	—	—	—	—		—	—	
1							—	—	
2									
Supplementary information:									
Sample		Test Date (YYYY-MM-DD) start/end.....:							
Test cycle	Light source	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)	
Initial	—	—	—	—	—		—	—	
1							—	—	
2									
Supplementary information:									

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Clause	Requirement + Test	Result - Remark		Verdict
Step 3: Stabilization determination				
		Sample	Sample	Sample
Stable power P _{max1} after alternative stabilization (W)				
Stable power P _{max2} after light exposure (W)				
Power change P _{max2} to P _{max1} (%)				
Allowed power change P _{max2} to P _{max1} (%)				
Is alternative stabilization method valid? (Yes/No)				
Supplementary information:				

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Clause	Requirement + Test	Result - Remark	Verdict

Annex 3: Lower and higher output power modules

TABLE A.4.1 Performance at STC before initial stabilization (Front side)							P
Test Date [YYYY-MM-DD].....:				2023-01-18			—
Test method.....:				☒ Simulator ☐ Natural sunlight			—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result
HA2023TL-0093-020X	14.624	51.434	14.034	43.027	603.840	80.28	P
HA2023TL-0093-021X	14.673	51.400	14.077	42.978	605.020	80.22	P
HA2023TL-0093-022X	14.284	51.182	13.671	42.962	587.326	80.34	P
HA2023TL-0093-023X	14.295	51.193	13.637	43.018	586.643	80.16	P
HA2023TL-0093-028X	13.849	51.165	12.917	42.917	554.354	78.23	P
HA2023TL-0093-029X	13.772	51.120	12.955	42.704	553.236	78.58	P
HA2023TL-0093-030X	14.222	52.436	13.269	44.128	585.516	78.52	P
HA2023TL-0093-031X	14.236	52.508	13.321	43.995	586.078	78.40	P
Supplementary information: The limit value is calculated through considering the tolerance of rated label values and lab measurement uncertainty.							

TABLE A.4.4: MQT 19.1 ini: Initial Stabilization procedure							P
Light exposure method		☒ Simulator ☐ Natural sunlight					—
Abbreviation: Regarding light source “S” for Solar simulator and “N” for Natural sunlight							
Stabilization criterion x per IEC 61215-1-x...:		1					—
Sample #	HA2023TL-0093-020X	Test Date (YYYY-MM-DD) start/end.....:			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m²)	Irradiance (W/m²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} – P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	603.840	—	—
1	5	800-1000	50±10	3.1	605.369	—	—
2	5	800-1000	50±10	3.1	606.915	0.51	Yes
Sample #	HA2023TL-0093-021X	Test Date (YYYY-MM-DD) start/end.....:			2023-01-28/2023-02-06		

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Clause	Requirement + Test				Result - Remark		Verdict
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} - P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	605.020	—	—
1	5	800-1000	50±10	3.1	606.638	—	—
2	5	800-1000	50±10	3.1	607.451	0.40	Yes
Sample #	HA2023TL-0093-022X	Test Date (YYYY-MM-DD) start/end :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} - P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	587.326	—	—
1	5	800-1000	50±10	3.1	588.624	—	—
2	5	800-1000	50±10	3.1	589.776	0.42	YES
Sample #	HA2023TL-0093-023X	Test Date (YYYY-MM-DD) start/end :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} - P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	586.643	—	—
1	5	800-1000	50±10	3.2	587.380	—	—
2	5	800-1000	50±10	3.1	590.028	0.58	YES
Sample #	HA2023TL-0093-028X	Test Date (YYYY-MM-DD) start/end :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} - P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	554.354	—	—
1	5	800-1000	50±10	MPPT	555.587	—	—
2	5	800-1000	50±10	MPPT	556.442	0.38	YES
Sample #	HA2023TL-0093-029X	Test Date (YYYY-MM-DD) start/end :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} - P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	553.236	—	—
1	5	800-1000	50±10	MPPT	554.485	—	—
2	5	800-1000	50±10	MPPT	555.471	0.40	YES

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IEC 61215-2							
Clause	Requirement + Test				Result - Remark		Verdict
Sample #	HA2023TL-0093-30X	Test Date (YYYY-MM-DD) start/end :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} - P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	585.516	—	—
1	5	800-1000	50 ± 10	MPPT	586.195	—	—
2	5	800-1000	50 ± 10	MPPT	588.126	0.44	YES
Sample #	HA2023TL-0093-031X	Test Date (YYYY-MM-DD) start/end :			2023-01-28/2023-02-06		
Test cycle	Integrated irradiation (kWh/m ²)	Irradiance (W/m ²)	Module temperature (°C)	Resistive load	P _{max} (W) at the end of cycle	P _{max} - P _{min} / P _{average} (%)	Stable (Yes/No)
Initial	—	—	—	—	586.078	—	—
1	5	800-1000	50 ± 10	MPPT	586.663	—	—
2	5	800-1000	50 ± 10	MPPT	589.026	0.50	YES
Supplementary information:							
☐ Other stabilization procedures							
Sample #	Test Date (YYYY-MM-DD) start/end						
Low 1							
Low 2							
High 1							
High 2							
Test method description:							
Supplementary information: see Annex 3 for verification of this alternative stabilization procedure							

TABLE A.4.7: MQT 6.1 Performance at STC after initial stabilization (Front side)								P
Test Date [YYYY-MM-DD]				2023-02-06				—
				Lower end power class		Higher end power class		—
Pmax(lab) (W)				≤ <u>608.239</u>	≥ <u>547.985</u>	≥ <u>586.106</u>		—
$\bar{P}_{max}(Lab)$ (W)				≥ <u>564.933</u>		≥ <u>604.233</u>		—
Pmax4(la) (W)				580		—		
Voc(lab) (V)				≤ <u>52.172</u>		≤ <u>53.765</u>		—
Isc (lab) (A)				≤ <u>14.685</u>		≤ <u>15.144</u>		—
Test method				☒ Simulator ☐ Natural sunlight				—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	Pmax [W]	FF [%]	Result	

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Clause	Requirement + Test				Result - Remark		Verdict
HA2023TL-0093-020X	14.664	51.471	14.097	43.052	606.915	80.41	P
HA2023TL-0093-021X	14.693	51.442	14.114	43.039	607.451	80.37	P
HA2023TL-0093-022X	14.325	51.159	13.718	42.992	589.776	80.47	P
HA2023TL-0093-023X	14.347	51.250	13.726	42.987	590.028	80.24	P
Supplementary information: The limit value is calculated through considering the tolerance of rated label values and lab measurement uncertainty.							

TABLE A.4.7: MQT 6.1 Performance at STC after initial stabilization (Front side)							P
Test Date [YYYY-MM-DD]				2023-02-06			—
				Lower end power class		Higher end power class	—
P _{max} (lab) (W)				≤ <u>587.265</u>	≥ <u>528.925</u>	≥ <u>562.280</u>	—
$\bar{P}_{max}(Lab)$ (W)				≥ <u>545.283</u>		≥ <u>579.670</u>	—
P _{max4} (la) (W)				560		—	
Voc(lab) (V)				≤ <u>52.273</u>		≤ <u>53.683</u>	—
Isc (lab) (A)				≤ <u>14.103</u>		≤ <u>14.522</u>	—
Test method				☒ Simulator ☐ Natural sunlight			—
Sample #	Isc [A]	Voc [V]	Imp [A]	Vmp [V]	P _{max} [W]	FF [%]	Result
HA2023TL-0093-028X	13.855	51.196	12.982	42.863	556.442	78.44	P
HA2023TL-0093-029X	13.827	51.122	13.029	42.633	555.471	78.59	P
HA2023TL-0093-030X	14.181	52.453	13.372	43.981	588.126	79.06	P
HA2023TL-0093-031X	14.214	52.536	13.370	44.057	589.026	78.88	P
Supplementary information: The limit value is calculated through considering the tolerance of rated label values and lab measurement uncertainty.							

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Clause	Requirement + Test	Result - Remark	Verdict

Annex 4: List of measurement equipment

A completed list of used test equipment shall be provided in the Test Reports when a Manufacturer Testing Laboratory according to CTF stage 1 or CTF stage 2 procedure has been used.

Note: This page may be removed when CTF stage 1 or CTF stage 2 are not used. See also clause 4.8 in OD 2020 for more details.

[illegible]